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SISAL HEMP.

The achievement of the Ceylon Hemp and Produce Company, in bringing their undertaking at Mahaillupalama in the dry zone of Ceylon to the producing stage, marks one of the most important advances that has yet been made in the history of planting enterprise in Ceylon. It is not always realised even in this country, though its prosperity is almost entirely dependent upon the plantation industry, what a comparatively small area is actually under cultivation. The greater part of the Island, the dry zone, remains uncultivated, because it is unsuited for the growth of our staple crops, and it has long been the aim of all our agricultural advisers to find some crop which would prove remunerative in that region. In developing Mahaillupalama under Sisal, and thus paving the way towards the utilisation of the dry zone, the promoters of this undertaking have earned the gratitude of the community.

Sisal Hemp was introduced into Ceylon in 1890. As in the case of other plants, this was an introduction by the Botanic Gardens with the usual object of ascertaining whether the plant would grow here. It was known to be a valuable fibre plant, but in those days the market was well supplied by the Mexican product, and there was no sufficient inducement to plant it in Ceylon. Later, it was re-introduced and planted at Mahaillupalama, then the Dry Zone Experiment Station, but its development on a scale sufficiently large to warrant the erection of the necessary machinery for extracting the fibre was beyond the resources of a Government establishment.

At the present day, the commercial prospects are totally different from what they were thirty years ago. The demand for fibres of all kinds has increased enormously, and the supply has failed to keep pace with the demand. What was formerly unremunerative is now a lucrative proposition. As regards Sisal Hemp, we are informed that more than nine-tenths of the annual export of this fibre from Mexico, the original home of the plant, is now taken by the United States, and consequently European buyers must look elsewhere for their supplies.

The cultivation of Sisal Hemp in Ceylon and the East has been retarded by the history of past failures with similar fibres, and these failures are still being cast up against present day attempts in the same field. But apart from the altered commercial conditions to which we have already referred, there are several adequate explanations of these early failures. One reason is that it was considered that, as any Agave will yield fibre, any Agave will pay to cultivate. That is not the case, even at the present day. A recent critic of the Ceylon undertaking points to the failure of *Agave americana* in South India. If he has got the name right there is no wonder the cultivation was unprofitable, for the fibre of *Agave americana* is of poor quality.

A further cause of failure was the old one of insufficiency of capital, both for the adequate extension of the area under cultivation and for the provision of the necessary machinery at the expiration of the long period of waiting for the plants to mature. It is not possible to begin fibre cultivation (other than by native methods) on a small scale and with makeshift apparatus, as in the early days of tea and rubber. There is an economic minimum as regards the size of the area under cultivation, and in the case of Sisal Hemp that minimum is a fairly large one.

The activities of the Ceylon Hemp and Produce Company will be watched with the greatest interest, and we have faith that the results will lead others to follow their example.

FIBRES.

SISAL HEMP CULTIVATION.

The following extract is taken from a paper on "The Present Position of Sisal Hemp Cultivation, with Special Reference to the British Empire" presented at a Conference held in connection with the Sixth International Exhibition of Rubber, Other Tropical Products and Allied Industries, Brussels, April 1924, by Ernest Goulding, D.Sc. (Lond.), F.I.C., Superintendent of Investigations, Imperial Institute, and reproduced in the *Bulletin of the Imperial Institute*, Vol. XXII., No. 1

The well-known cordage fibre, Sisal hemp, is derived from the leaves of certain species of Agave. The name is now usually restricted to the product of *Agave sisalana* Perr. (*A. rigida* Miller, var. *sisalana*), although it was first applied to the fibre produced in Yucatan, Mexico, mainly from the leaves of *A. fourcroydes* Lem. (*A. rigida* Miller, var. *elongata* Jacobi). The latter fibre is commonly distinguished as "Henequen," or "Mexican Sisal."

The true Sisal hemp plant is a native of Central America, but has been introduced into most tropical countries, including Florida, the West Indies, South Africa, East Africa, West Africa, Madagascar, Mauritius, India, Indo-China, the Dutch East Indies, the Philippine Islands, the tropical parts of Australia, Papua, Fiji and Hawaii.

The earliest efforts to introduce the fibres into commerce were concerned with henequen and were made in Mexico in 1839. It was found, however, that the preparation of the fibre by the primitive methods then employed was so slow and tedious that even with the cheap labour available the cost of production was discouraging. Some years later a simple machine was invented, and its employment led to a gradual expansion of the industry.

It is estimated that the annual production of fibre in Mexico is now about 150,000 tons when the plantations are working at their full capacity. A large proportion of the product (probably over 90 per cent.) is exported to the United States, where it is employed for the manufacture of the binder twine used in harvesting the immense grain crops of the Western States. The present demand for binder twine for this purpose amounts to about 200 million lb. annually. The output of fibre from Mexico has not been seriously reduced by the political and military disturbances of recent years, but during the latter half of 1923, transport difficulties occurred owing to the revolution and the occupation of the country by the rebels, and exports temporarily ceased. As a result of the uncertainty of Mexican supplies, European manufacturers have turned their attention to African Sisal hemp and it is probable that they will continue to use this in preference to the Mexican product unless substantial advantages are offered. In any case, it is unlikely that in future there will be much Mexican fibre available for the European market after the needs of American consumers have been fully met.

It is evident that in order to ensure a sufficient supply of Sisal hemp for the needs of European manufacturers, the production in countries other than Mexico should be greatly increased and the industry introduced if possible into new regions.

It has therefore been considered of interest to give a brief account of the efforts which have been made to establish Sisal hemp cultivation within the British Empire, together with an indication of the present position and prospects of the industry in each of the countries in which the growth of the crop has been attempted.

It will be seen that the only British countries at present producing the fibre on an extensive scale are East Africa (Kenya and Tanganyika) and the Bahamas, but that commercial supplies may be expected in the near future from Ceylon, Nyasaland, Gold Coast, Mauritius and Jamaica. Several other countries are well adapted to the crop and have extensive areas available for cultivation.

The results of the attempts to develop a Sisal hemp industry in these various countries have confirmed the view that the crop cannot be profitably produced unless the operations are carried out on a large scale and with the employment of modern machinery. As one extraction machine is capable of preparing from 500 to 600 tons of fibre per annum and the average production of the fibre is about 1 ton per acre, it is evident that an area of from 500 to 600 acres of mature plants must be annually available for each. As the plants take some years to come to maturity and are only available for cutting for a limited period, it is obvious that fresh areas must be planted in succession in order that the machines may be continuously supplied. This question need not be considered in fuller detail, as an excellent discussion of the subject has been published by Major L. A. Notcutt, M.C., A.R.S.M., in a supplement to the issue of *Tropical Life* of April, 1923. Major Notcutt, who has had considerable experience of Sisal hemp growing in Portuguese East Africa and has also studied the question in Kenya and Tanganyika, recommends the planting of a fresh section of 600 acres each year, and suggests a scheme which would involve the planting of total area of 7,200 acres and the installation of six extraction machines. This he considers should be regarded as the minimum scale of operations for the establishment of a profitable industry.

ASIA.

India:—The production of Sisal hemp in India has not assumed important dimensions although attempts to cultivate the crop on a commercial scale have been made in Assam, Bombay and Southern India, and fibre has been extracted from plants growing beside the railway in the Coimbatore District, Madras. In the Central Provinces, *Agave Cantala*, the source of the "maguey" fibre of the Philippines, a product resembling Sisal hemp, is grown to some extent as a hedge-plant, but comparatively little fibre is extracted. During recent years some attention has been given to Sisal hemp in Burma, but no large quantities of fibre have yet been produced.

In Mysore several species of Agave are planted as hedges, but these are not of much value as a source of fibre. The true Sisal hemp plant was introduced in 1892 and has been cultivated to some extent in the Lal Bagh

Gardens in Bangalore. Efforts are being made to grow the crop on a commercial scale in Mysore, but no results of importance have yet been obtained. Just outside the borders of the State in Coorg, however, a small plantation of Sisal hemp has been worked successfully for several years.

Ceylon:—Sisal hemp was grown for several years by the Department of Agriculture of Ceylon at the Mahaillupalama Experiment Station in the North-Central Province and satisfactory results were obtained. In 1918 this Station was closed, but with a view to continuing the experiments and extending the cultivation a syndicate was formed which was granted a concession of 2,200 acres of Crown Lands on special terms. Work was started in 1919 and good progress has been made. Fibre of excellent quality has been produced. and it is considered that, with the introduction of efficient machinery, a product will be obtainable on a commercial scale which should compare favourably with that from any other source. From the results already obtained at Mahaillupalama it has been estimated that the cost of production of the fibre should not exceed £10 to £12 per ton. There are good grounds for anticipating that the enterprise will be fully successful and, if such should be the case, it is probable that the industry will undergo great expansion as there are vast areas available in the dry zone of the Colony which are at present uncultivated and would be quite suitable for Sisal hemp [Since the above was written, a factory with modern machinery has been installed by the Ceylon Hemp and Produce Company.—Ed.]

The Agricultural Department is convinced that Ceylon offers great possibilities for fibre production, and since 1918 has had areas of Sisal under cultivation at Anuradhapura, where a small mill has been established for extracting the fibre. The Department is also undertaking small experimental trials at Jaffna and Hambantota, in the extreme north and extreme south of the Island respectively. Large numbers of plants have been distributed, mainly to the Southern Province and the Kurunegala District of the North-Western Province.

Federated Malay States:—There is no doubt that Sisal hemp can be grown satisfactorily in the Malay Peninsula. The Department of Agriculture have grown the plant experimentally for some years and recently interest has been taken in the crop by planters, and it is now being cultivated on a small scale on three estates. The necessity of growing the crop on a sufficiently large scale to justify the introduction of modern extracting machinery has hitherto militated against the establishment of the industry on commercial lines.

North Borneo:—The climate and soil of North Borneo are admirably suited to Sisal hemp cultivation, and some of the comparatively dry areas in the interior near the terminus of the railway are particularly favourable for the crop. Hitherto the plant has been grown only on an experimental scale, but it is considered that the country offers excellent possibilities for the establishment of a successful fibre industry.

THE CULTIVATION OF THE COTTON PLANT IN THE FRENCH SUDAN.

ACCLIMATIZATION OF THE AMERICAN ACALA VARIETY.

J. VUILLET,

Director of Agriculture, French Sudan.

(Translated from Revue de Botanique Appliquée, Vol. IV., No. 33, by H. L. Ludowyk, Librarian, Department of Agriculture, Ceylon.)

The French Cotton industry, on account of the difficulties experienced in obtaining American cotton, is seeking Sudan cotton, the production of which tends, in consequence of this fact, to develop rather rapidly. However, if the lack of uniformity and the shortness of the fibre, considered for a very long time as defects which prevented its sale, do not any longer present an obstacle to its use in the mother country, the indigenous cotton plants of the Sudan present certain characters of such nature as to render their cultivation of small advantage : these are specially the small size of the boll, the low yield of raw produce in fibre fit for ginning and the late fructification of the plant. This consideration has led the Governor-General of French West Africa to try systematically, in the valley of the Niger, the cultivation of certain Uplands improved by American selectors.

Among the different types introduced in 1922 with this object, the Acala, which, without irrigation, has frequently furnished yields exceeding 600 Kgs. of raw fibre per Hectare on the experimental fields of the Station of Nieneable (Segou Circle) gives the best prospects. As the results obtained are on the whole inferior to those given by the same variety in the United States, observations have been made with a view to verify whether the modifications undergone by the plant are of a permanent character, like those corresponding with the adaptation of a plant to certain exterior conditions, or whether it is only a case of the "new-place effects" of Cook.

As O. F. Cook, Biologist of the Department of Agriculture, has shown in the United States, changes of place can produce in the cotton plant certain modifications of a profound, but not permanent character (New-place effects). * These temporary alterations are impressed especially on the pods, the number and size of which diminish, as well as on the number of loculi.

The phenomenon has been closely followed for Kekchi, an upland, native to the Western part of Guatemala. Directly imported seed sown in Texas gave rise to stock transformed to such an extent by the change of place that unless one had been certain of the origin of the seed, it was not possible for one to conceive that it was the same plant. Subsequently in five or six generations, the cotton plant resumed its normal characters and regained its original productivity.

The observations made in the French Sudan on Acala during the course of the last season relate to four rows of two fields, sown, for the sake of comparison, part with seed coming direct from the selection field

* Cf. O. F. Cook, *Heredity and Cotton Breeding*. Washington, 1913.

of the Government Date Garden of Indio, California, part with seed gathered in the preceding year on a plot of the Agricultural Station of Koulikora in the valley of the Niger. For these rows there have been determined : 1st, the total production up to the 30th November; 2nd, the average weight of raw cotton per boll; 3rd, the proportion of the bolls with 5, 4 and 3 loculi.

The results of this study are summarised in the following table:—

Field	Nature of Seed	Yield of the row up to 30th November	Raw cotton per Boll	Percentage of Bolls with 5 loculi	Percentage of Bolls with 4 loculi	Percentage of Bolls with 3 loculi
1	Direct Importation -	29·820 Kg.	4·44 g.	58·23	41·15	0·62
	Seed from Koulikora -	41·475 Kg.	4·85 g.	61·14	38·70	0·16
2	Direct Importation -	85·45 Kg.	3·46 g.	55·22	43·10	1·68
	Seed from Koulikora -	80·10 Kg.	3·82 g.	66·60	33·20	0·20

Although the parallel rows have been chosen in such a manner as to enable them to be as comparable as possible, one is hardly able to estimate the difference in yield, this being of the degree frequently observed between rows of the same plot. On the other hand, the increase in the size of the bolls, and the increase in the number of bolls having five loculi, seem to signify a natural tendency of the plant to return to the original type, which tendency one may hope to see accentuated in succeeding years, especially if one proceeds with the selection of the best lines.

The practical importance of a recognition of such a phenomenon is easily seen. It has indeed up to now been the common belief that the improved cotton plants introduced into the Sudan degenerate, and that this degeneracy can be only accentuated with time. Observations made in a province of the lacustrine zone of the valley of the Niger, where cotton plants of the Egyptian type are cultivated under irrigation, corroborate those reported above : the plantations of Sakellarides raised from seed gathered on the spot are this year distinctly finer than those grown from seed recently imported.

REPORT ON ROSELLE FIBRE FROM CEYLON.

The Roselle fibre (*Hibiscus Sabdariffa* var. *altissima*) which is the subject of this report was forwarded to the Imperial Institute by the Director of Agriculture.

The fibre was grown and retted on the Experiment Station, Peradeniya, and it was desired to ascertain its quality and value.

DESCRIPTION.

The sample weighed 109 lb. and consisted of two large bundles of fibre, each composed of about 40 smaller bundles of an average weight of 1¼ lb. The fibre had good lustre, and was mostly of a greyish-cream tint, though some portions were pale brown. Some of the fibre was coarse, discoloured and rather interlaced, especially towards the butt ends, where it was largely of a grey tint and rather hard and gummy. Some hard "runners" were present, together with fragments of adherent bark.

The material was on the whole of good strength, but some rather weak fibre was present. The length of staple was from 6 to 13 feet, with an average of about 10 feet.

RESULTS OF EXAMINATION.

The fibre was submitted to chemical examination and the results are given below in comparison with those furnished by a commercial sample of Bimlipatam jute (*Hibiscus cannabinus*) examined at the Imperial Institute:—

	Present Sample per cent.	Bimlipatam Jute per cent.
Moisture	7·5	12·5
Ash	0·8	1·3
a-Hydrolysis, loss ...	11·5	11·8
b-Hydrolysis, loss ...	13·7	15·1
Acid purification, loss ...	1·7	not determined
Water-washing, loss ...	0·9	not determined
Cellulose	74·2	75·4

The ultimate fibres of the present sample measured from 1·5 to 4·5 with an average of 2·5 mm.

These results show that the fibre is satisfactory in composition and in its behaviour towards chemical reagents and that in these respects it resembles Bimlipatam jute.

COMMERCIAL VALUE.

The fibre was valued by merchants in London at £27 per ton, with "first marks" Calcutta jute at £26 per ton (May, 1924). In this connection it may be pointed out that the current values of jute are abnormally low.

REMARKS.

As stated above, portions of the sample were rather gummy, interlaced and discoloured, but on the whole the fibre was fairly well cleaned and prepared. The merchants considered that consignments of similar quality should be readily saleable in London for use in admixture with jute and possibly with certain of the lower grades of hemp. The price would approximate to the current value of "first marks" Calcutta jute.

If commercial supplies of Roselle fibre become available in Ceylon, it would be advisable to cut off a few inches from the butt ends, as is done in the case of Calcutta jute. This would improve the value of the fibre, and the cuttings could be marketed separately as paper-making material.

DYE STUFF.

THE EXPLOITATION OF THE TANNIN MANGROVES AND THEIR VALUE, ACCORDING TO SOME RECENT WORK.

AUGUSTE CHEVALIER.

(*Translated from the Revue de Botanique appliquée by H. L. Ludowyk, Librarian, Department of Agriculture, Ceylon.*)

The *Bulletin de l' Agencie generale des Colonies*, *Year* XVI, 1923, p. 712, publishes an interesting study of the tanning barks of Madagascar, made by Monsieur F. Heim with the collaboration of Dr. E. Schell, president of the French section of the Society of Chemists of the Leather Industries.

The Mangrove plants of the tropical seas are now conspicuously known. In Madagascar especially they have been studied with the greatest care by our collaborator, Perrier de la Bathie, who has summarised his observations in his admirable work on the *Vegetation of Madagascar* cited further on.

We have studied the same vegetation on the coasts of Indo-China and of Western and Equatorial Africa. It is a curious fact that, for the greater part, the same species exist on all the coasts of the Pacific, from the East Coast of Africa, and from Madagascar as far as Indo-Malaysia, Indo-China, the Philippines, the Indian Archipelago. On the coasts of the Atlantic there exist allied species, and even identical species, such as *Bruguiera gymnorhiza*.

If these plants are well known from the botanical point of view and from the point of view of geographical distribution, yet from the chemical and industrial standpoint the authors who have been engaged on the utilisation of Mangrove barks are far from being in agreement.

It is now well admitted that the only barks that can be used are those of *Rhizophora*, *Bruguiera*, *Ceriops*, and *Carapa* (*Xylocarpus*). We have come to the same conclusion as regards the Mangroves of Indo-China.

Messieurs F. Heim and E. Schell give in the notes summarised below, the chemical and technological analyses of seven species of bark which had been sent to them by the Forest Service of Madagascar.

Only three species have proved of interest for the tanner and to be of value to the tanyard and the tanning extract industry; two others present only a slight interest; and finally, the last two are altogether valueless.

We enumerate these species below, adding to the summarised facts of Messieurs Heim and Schell some information regarding the plants and their tannin content according to the analyses made in other countries.

The species of Madagascar, according to Heim and Schell, are the following:

RHIZOPHORA MUCRONATA Lamk.

Honkolahy in the Madagascar Vernacular.

The analyses have given 35 to 37 per cent. tannin out of 46 per cent. soluble matter. The tannins are very soluble in the cold. The tanning value is satisfactory. Sheep skins were sufficiently swelled and entirely

permeated; suppleness medium; surface sufficiently smooth. This species constitutes 40 per cent. of the Magadascar mangroves.

Its height is given as 18 metres, and the dimensions of the stock 9 metres long by 1·75 metres circumference. These dimensions, we believe, are rarely reached.

Vernet has found that the barks of Rhizophora in Cochin-China contain 58 per cent. tannin in the fresh material and 30 per cent. dry extract in the liquid expressed.

For the *Rhizophora mucronata* of Tonkin collected by us, M. Tardivot, Chemist of the Society of Tanners of Indo-China, found in the dry bark only 15·33 per cent. of matter fixable by hide. Bacon and Gana indicate a tannin content of 21·6 per cent. in the same species growing in the Philippines, and 20 per cent. in the Borneo product.

BRUGUIERA GYMNORHIZA Lank.

Tsitolona in the Madagascar Vernacular.

The analyses of the bark have given 27·23 per cent. tannin in 34·14 per cent. soluble matter. Fairly easy to reduce to powder; ease of extraction normal; tannins very soluble in the cold. Tanning value satisfactory. Hides sufficiently swelled and entirely permeated; suppleness medium; surface sufficiently smooth.

Height of the tree 15 metres, with a stock 9 metres x 1·50 metres. It represents 20 per cent. of the Madagascar mangroves.

The *Vogia* of Cochin-China, analysed by Vernet probably belongs to this species; the bark of this was found to contain only 10·76 per cent. tannin; the dry extract contained 38·36 per cent. tannin.

In the bark of *Bruguiera mucronata* which we collected in Tonkin, M. Tardivot found 16 to 20·24 per cent. tannin.

Bacon and Gana found about 27 to 28 per cent. in the bark of the same plant obtained from Borneo.

CERIOPS BOIVINIANA Tul.

Honkovavy in the Madagascar Vernacular.

The analyses of the bark have given 23·40 per cent. tannin for 30·9 per cent. soluble matter. Fairly easy to reduce to a powder, but the ease of extraction is medium. Tannin value satisfactory. Hide sufficiently swelled and entirely permeated. Suppleness medium; surface sufficiently smooth.

Height of the tree 14 metres, with a stock 10 metres x 1·10 metres circumference; represents 30 per cent. of the Madagascar mangroves.

This species is peculiar to Madagascar, but *Ceriops Tagal* which grows in the Philippines contains 21 to 23 per cent. tannin in its bark, and the same species in Borneo contains 29·3 per cent. tannin (Bacon and Gana).

CARAPA OBOVATA Blume.

Foby in the Madagascar Vernacular,

The analyses of the bark have given 23·78 per cent. tannin out of 31·06 per cent. soluble matter. Easily reduced to powder; ease of extraction normal. Tanning value middling. Hide incompletely permeated; suppleness inconsiderable.

Height 10 metres, with a stock 4 metres x 0·60 metres circumference.

It amounts to 20 per cent. of the Madagascar mangroves.

The bark of the same plant growing in Tonkin (Bay of Along) gave M. Tardivot 28·78 per cent. tannin; and a plant akin to it, *Xylocarpus granatum* Koen. contains 24·7 per cent. tannin (Bacon and Gana).

HERITIERA LITTORALIS Dryand.

Moromona in the Madagascar Vernacular.

The analyses of the bark gave 11·6 per cent. tannin out of 18 per cent. soluble matter. Fairly easy to reduce to a powder; ease of extraction normal. Of negligible tanning value. Hide badly tanned, like pasteboard, thin and without suppleness. A plant to be rejected. It represents, moreover, only 2·50 per cent. of the Madagascar mangroves.

The other Mangrove barks analysed by Messieurs. Heim and Schell are of no value. This is the case, for example, with the Afiafy, or *Avicennia officinalis* L., the bark of which contains only 0·94 per cent. tannin.

The conclusions of Messieurs. Heim and Schell are as follows:

It appears as a result of these researches that, of the Madagascar Mangroves, the only profitable trees for the exploitation of bark with a view to export would be *Rhizophora Bruguiera*, *Ceriops*, and *Carapa*, (*Xylocarpus*).

In *Rhizophora* and *Bruguiera* the content of substances absorbable by hide powder seems to fluctuate from 28 to 42 per cent. with an average of 36 per cent., the content of those of *Carapa* (*Xylocarpus*), from 27 to 33 per cent., average 30 per cent., and *Ceriops* from 24 to 32 per cent., average 26 per cent.

It should be noted that all these barks give a tannic purity (deduced from the ratio of tannin to non-tannin) of at least 70 per cent. and well beyond, a suitable condition for the manufacture of marketable extracts.

It does not now seem profitable to transport barks of an inferior content, but these may eventually find some local use.

If we glance at the actual state of the market for barks and tanning materials, it is evident that its demands appear to be based on barks of 38-42 per cent. tannin content, and according to the data given above, the *Rhizophora* barks alone will be selected as being capable of reaching up to the standard: 30 per cent. for the liquid extract and 58 to 60 per cent. for the dry extract.

"For obtaining such extracts it is necessary that the raw material which goes to make them should have a tannic purity of at least 70 per cent."

In addition, the actual cost of freight precludes the possibility of transporting all the barks that have too low a content of the useful constituents.

H. Perrier de la Bathie gave recently the following appreciation of the Mangrove vegetation of Madagascar:

"The Mangrove formation, which covers about 400,000 hectares of the island, is interesting from an economic point of view. It is, in the first place, an important reserve of fire-wood, which is precious in a country where wood is often scarce, and it is admirably placed for being exploited. Moreover, in recent years the bark of *Rhizophora mucronata* has been exported on a large commercial scale as tanning material. The stocks of this species have now been almost totally destroyed; but the species has a rapid growth, its dissemination is prolific, and if care is taken to preserve at intervals some adult plants for the purpose of reproduction, their numbers will soon increase. *Ceriops Boiviniana* and *Bruguiera gymnorhiza* are equally rich in tannin."

I may add that these plants can be cultivated and subjected to intensive exploitation, as is already being done in certain countries.

At the south of the China sea, the Chinese and the Annamites have for centuries known how to propagate and rationally exploit the Mangroves.

Before the War the Forest Service of the Philippines had already published very interesting information on this subject.

We ourselves have found that this cultivation is carried on also in Tonkin along the shores of the Bay of Along.

The natives gather the young *Rhizophora* and *Bruguiera* plants as they are detached, and they transplant them, burying them vertically with the root downwards, in the mud flats when the latter are left exposed by the tide. The Forest Service of Tonkin has taken in hand the replenishing of the natural stocks of Mangroves, to which subject we shall return another time.

Finally, it may be remarked that all the mangroves belonging to the same species do not have the same tannin content in their barks. There will then have to be some way of selecting the young plants that are to be propagated.

M. Vernet, among others, has shown that in the same species the tannin content in the bark is very variable according to the age and the part of the plant utilised. Thus in *Vo Duoc*, *Rhizophora* sp., the tannin content of the bark diminishes from the base to the summit of the tree, but the bark of the branches is, nevertheless, exploitable, being given a sufficiently high degree.

On the contrary, the wood of the trunk is poor in tannin although that of the twigs can be utilised.

In the case of *Vo Gia*, *Bruguiera* sp., on the contrary, all parts of the tree (wood and bark) can be used industrially.

When the tannin content of the barks of the Mangroves is estimated, it is of advantage to indicate the approximate age of the trees and the position of the barks on the different parts of the plant.

A METHOD FOR THE QUANTITATIVE ESTIMATION OF TANNIN IN PLANT TISSUE.

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The literature of this subject makes no mention of a process for the estimation of small quantities of tannin in plant tissues. The author made a study of the grain-sorghums and describes the method used for this purpose, in which a colour-reagent is employed. The colour reagent is made by boiling 100 gm. of pure sodium tungstate, 30 gm. pure arsenic acid (As^2O^5) with 300 cc. water and 50 cc. conc. hydrochloric acid for two or three hours under a reflex condenser. The solution is then cooled and diluted to 1 litre.

Among other results quoted are included, darso, 0·4% tannin ; white kafir, trace, African millet, 2·7 ; broom corn, 4%—International Review of the Science and Practice of Agriculture, Vol. II., No. 1.

PESTS AND DISEASES.

INSECT PESTS OF COTTON.

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and

OWEN B. LEAN, B.Sc.

The cotton plant, wherever it is grown, suffers from insect pests to an extent really greater than most staple crops. One reason is that it is one of the *Malvaceæ*, a family of plants which is widely spread both wild and in cultivation. Insects which have adapted themselves to any species of *Gossypium*, of *Hibiscus*, of *Abelmoschus*, seem to be able to adapt themselves readily to cotton, and this means that wherever cotton is brought into cultivation in new areas insect pests soon thrive upon it.

A second reason why insect pests are important is that we grow cotton for the sake of the fibre, which is formed round the seed in the boll: the boll is a very attractive breeding material for insects, with its content of soft, puffy, developing seeds, and the result is that the fibre, which is our main concern, suffers damage due to insects seeking to live on the seed.

To the cotton grower the insect pest is a real danger, and the whole industry which ultimately depends upon the produce of the cotton plant, has been very deeply affected by the attacks of pests such as the boll-weevil and boll-worm.

In the following pages are given a general account of the more important pests; perhaps those who deal in cotton, who use it in manufacture, will be interested in knowing of the pests which beset the grower. It is a far cry from the cotton grown in the fields of Queensland to the mill in Lancashire, but the influence of the insect in the fields is felt even in the mill, and will probably be felt even more in the future.

THE STATUS OF THE INSECT PESTS OF THE GROWING COTTON PLANT.

The cotton plant is an important source of food to the teeming insect fauna of the tropics. More species of insects appear to attack cotton than any other cultivated plant. Over five hundred species of insects—and with the insects are included a number of other deleterious invertebrates amongst which mites are the most important—have been mentioned at one time or another as feeding on cotton. It is attacked in all stages and in all its structures. The seedlings, as soon as they appear above ground, are devoured by grasshoppers, lepidopterous larvæ or cutworms, and herbivorous feeding beetles, to such an extent that acres have frequently to be resown. The older but still succulent plants suffer especially from attack to the developing leaf buds, to the flower buds, or squares, and to the tender growing points of the stem, by the sap-sucking bugs, a fly maggot, and the boring lepidopterous larvæ. When the leaves are fully developed they are fed on by more

bugs, more lepidopterous larvæ, and a host of other insects such as mites, aphides, leaf-feeding beetle larvæ, leaf-boring fly grubs, thrips, and, in fact, by representatives of almost every insect order. Those flower buds that have escaped attack give rise to short-lived blooms which do not escape entirely, for they are attacked by flower beetles.

Meanwhile, the roots have not escaped attention; for the usual soil fauna or eelworms, millipedes, wireworms, and other beetle larvæ find in them abundant nourishment. But it is when the seeds begin to develop and the young green bolls form that the attacks become of real importance, for it is at this stage that most of the major insect pests of cotton become prevalent in the fields.

Up to the formation of the seeds all the boll-worms have to feed on the squares or on the inside of some green and tender shoot; but it is inside the bolls, actually feeding on the developing seed, and thus effectually decreasing the production of lint, that these pests become most numerous and important. It is, of course, at this stage also that the notorious Mexican boll-weevil becomes really serious and increases rapidly in numbers.

Whereas the boll-worms damage the cotton only as larvæ or caterpillars, the adults being harmless moths, the boll-weevil is important in both stages. The grubs feeding inside the boll prevent the formation of the seeds or reduce their vitality so that they do not produce good lint, while the adult beetles fly from plant to plant, feeding from the outside of the bolls and squares, and by means of a chiselling and boring movement reach the soft internal structures which are their main articles of diet.

Other important pests at this stage are the cotton stainers. These are true bugs, and like all bugs feed by sucking up the sap of the plants through their long proboscis, which is driven into the various plant tissues. The cotton stainers themselves feed on the bolls. Having pierced the surrounding bracts, the proboscis is forced into the developing seeds, from which the bugs extract the nutritious sap. The importance of these stainers is not, however, due so much to this direct damage, but more to the fact that they are the carriers of disease. In some way, as yet not fully understood, these insects transfer bacterial and fungoid disease from boll to boll as they feed. The infection, known as internal boll disease, causes a staining and rotting of the lint, depreciating its value and its quantity very considerably. This disease has been very prevalent in the West Indies, and recent investigation shows its presence in Tanganyika Territory and Nyasaland.

In this case the disease has been definitely found to be transferred by the stainers and a few other bugs. It is, however, more than probable that many other fungoid diseases are carried by insects that feed on the cotton and also that other diseases gain entrance into the tissues through the wounds caused by insect attack.

In another indirect way these stainers and a number of other insects are important. Thus, when the cotton is ginned the presence of large numbers of these insects produces a staining of the lint which can by no means be ignored.

From this brief survey it is obvious that the cotton plant is never free from the attentions of the insect fauna; the plant tissues are being devoured by one insect or another from the time of sowing until the picking is complete. It is a wonder that any crop can be gathered at all, and as Mason has pointed out, the boll-worms alone damage 70 per cent. of the crop in Nyasaland, and even under these conditions the growers procure a reasonable return so that the potential producing capacity of such a country is enormous.

The cotton plant, *Gossypium*, belongs to the natural order *Malvaceæ*, which also contains many common wild and cultivated plants that occur throughout the tropics; and it is only to be expected that in many cases we should find the cotton-feeding insects, in some cases willingly, and in others only in emergency, turning their attention to the other closely related malvaceous plants and, *vice versa*, when cotton is introduced into a country, the indigenous malvaceous-feeding insect fauna migrating to the cotton-fields where food may be found in plenty. The cotton plant seems particularly attractive, probably because of the sweet exudation of the glandular structures that are present on many of the plant organs. The various Hibiscus, Bhindi, Okra, Hemp, etc., and Hollyhock are examples of common malvaceous plants which may not only account for the origin of certain cotton pests, but also serve as the source of food which supports the pests throughout the winter months when cotton is unobtainable. For the above reason it is easy to understand the appearance of cotton pests wherever cotton be grown, and in any large cotton area we may be sure that sooner or later at least one of the cotton feeders will find the conditions suitable enough to enable it to attain the role of a major pest.

Thus in the American cotton belt the pest of primary importance is, of course, the boll-weevil. The story of this insect is well known, but a few of the outstanding facts may be mentioned here. The weevil is confined at present to Mexico, Central America, parts of Cuba, and the United States, but the exercise of great care will be required to prevent its accidental introduction into the cotton areas of the British Empire. The weevil is probably a native of Central America, where it fed on the native cotton trees, and it was little known until 1892, when it crossed the Rio Grande at Gainesville, and thus gained a footing in the United States. Since that date there has been an annual spreading of the pest in a northerly direction, until to-day it is found in every cotton-growing State. This rapid dispersion is due to a natural migratory habit of the adult weevils in the Autumn, when they take protracted flights in search of fresh feeding grounds. In 1922 the weevil infested 13,000 fresh square miles of the cotton belt. The weevil is endangering the cotton-growing industry of America, and, *pari passu*, the Lancashire cotton industry, for the financial loss due to the lessened production caused by direct attack is enormous. Some figures recently published in America are illuminating. In the years 1909—13 the average annual percentage of potential production prevented by the weevil was estimated at 5·1 per cent. In the years 1919—21, which are the last years for which these figures are available, the estimates are 13·7, 20·5 and 33·5 per cent. respectively. In 1921 the actual value at farm

prices of the picked product prevented by boll-weevil attack was estimated at 610,341,000 dollars; 90 per cent. of this represents loss in lint. It has been stated that the boll-weevil destroys more cotton than is used by all the cotton mills of this country.

The boll-weevil has fortunately a restricted distribution, but this cannot be said of the pink boll-worm (*Platyedra gossypiella*). This moth, for the worm is the caterpillar stage of a minute and insignificant moth, is found throughout the world, and is a serious menace to all cotton-growing countries. This insect's native home is probably in South-East Asia, though some authorities consider it as coming from the Sudan district. It was first recorded in India in 1843; it arrived in Egypt in either 1906 or 1907, probably by way of Palestine, and in Egypt it soon became dominant, and was recognized as an important pest in 1912. It had reached German East Africa in 1904, and since then the moth has spread to the Sudan, to East, West, and Central Africa, to Australia, across the Atlantic to both South and North America, and thence to the West Indies, arriving there as late as 1920. It is present in Hawaii, Fiji, and Mesopotamia. No reports of its presence have come from South Africa. The American outbreak is at present not serious, and the American entomologists expect to be able to exterminate it.

The life-history of the pink boll-worm is unfortunate. It is modified in such a way as to give the insect the very best chance of becoming dispersed to all the tropical regions of the world, where its food plants are grown.

Each female moth lays from 250 to 500 eggs on the cotton plant; in Egypt, for example, the first eggs are laid on cotton about June. After four to five days a very active little caterpillar emerges and immediately bores its way inside a boll or bud to feed on the inside of a seed or upon the ovules. The larva feeds for about twelve days, during which period it destroys two or three seeds, and then either within the boll or in the ground the larva turns into the pupal stage, which lasts on the average about ten days. The moth then emerges, and within a few days commences its egg-laying. In this way the complete life-cycle occupies only five weeks on the average, and much less in many cases. This is the usual procedure during the Summer months when food is abundant, but from September onwards an important change takes place. The larvæ, when they approach maturity, spin a cocoon within a seed, and in doing so are careful to spin up a second seed to cover up the entrance hole, forming what is known as the double seed. But instead of pupating these larvæ remain in a resting condition for a long period, tiding over the Winter months when food is scarce, and complete their development the following Spring. These resting-stage larvæ have been known to exist in this condition for as long as thirty months, and, of course, during this period the seed may be transported from one side of the world to another, the moths emerging in due course to infest fresh cotton areas. With reasonable care there is little likelihood of the boll-weevil spreading to the Old World, but with the pink boll-worm it is different, and unless all cotton seed that is transported away from any infected area is thoroughly disinfected by heat treatment, which ensures the death of all insect life, we may expect to hear of the gradual depreciation of the cotton production of those few remaining cotton fields that are free of the pink boll-worm.

The estimates of the damage caused by this pest in different parts of the world are by no means complete, but are of extraordinary interest. In Egypt, where the pest is most important, the percentage of seeds damaged was estimated to be in 1912 3·9 per cent., in 1915 this had risen to 10·7 per cent., and in 1916 to 15·1 per cent. To-day the damage is estimated at about 20 per cent. of the crop. In India an examination of a large number of bolls in 1919 showed that during July the percentage of attacked bolls rose from 40 to 80 per cent., and in September stood as high as 91·6 per cent. One estimate from the West Indies gives the loss in 1921 at 5 to 25 per cent. of the crop, and in Brazil it was estimated at 30 to 66 per cent. in 1917.

The pink boll-worm is a typical boll-worm in its damage, but it is only one of the many such pests. Other important moths are those belonging to the genus *Earias*; the most important of these, *E. insulana*, commonly known as the spiny boll-worm, is another very widely distributed insect. It is found throughout the African continent, it is common throughout India and Burma, and it has gained a footing in Queensland and also in Brazil. Another species, *E. fabia*, is only really serious in India, and especially so along the eastern coast. These two species have at times been especially noticeable, as in the years 1905, 1909, 1910 and 1918, and of these the 1905 outbreak was outstanding. Such a sudden outbreak emphasizes the importance of the natural control of insect pests by their natural enemies and the effects of abnormal weather conditions. In this year an unusually cold Winter killed off the principal insect parasites and predators, but did not harm the *Earias* themselves, so that in the Summer the moths were free to multiply unchecked. To prevent a recurrence of this catastrophe, the most important parasite, a minute braconid known as *Rhogas Lefroyis*, Ashm., is bred at the agricultural stations in India and immediately despatched to any district where the *Earias* seem to be dominant or where the parasite is noticeably absent.

This is the effect of a cold Winter in India: in America, under boll-weevil conditions, we find just the opposite. Here the weevil hibernates through the cold months, sheltering in fallen leaves, moss, and rank under-growth without feeding, and the number of beetles that emerges the following Spring to infest the new cotton crop varies according to the mean Winter temperature. During a mild Winter many beetles survive, but if there are long spells of frost only the hardiest or best protected beetles pull through and the cotton growers enjoy an unusually full crop.

There are two other boll-worms of major importance, the Sudan or red boll-worm (*Diparopsis castanea*, Hamps.), and the American boll-worm or corn earworm (*Chloridea obsoleta*, F.). The former is confined to the African continent, but is one of the most important pests to the British cotton grower. It is serious in the Sudan, Nigeria, Uganda, Nyasaland, and South Africa, but is noticeable for its absence from Egypt. From Nyasaland it is reported as a pest of great importance, and from South Africa as accounting for the destruction of 60 per cent. of the bolls. The American boll-worm, on the other hand, is another of the very widely distributed pests; it may be described as universally distributed, and occurs occasionally in this country; it feeds on many plants, and is a first-class pest on both maize and cotton.

It is second in importance to the boll-weevil in the United States, and its damage there to cotton alone was figured at 8,500,000 dollars in 1917, and to all crops at 30,000,000 dollars. In Egypt, on the other hand, it has only once (1905) been recorded as doing any appreciable harm. In India its status is very variable; in 1917 it was reported as occurring "on cotton but rather as a curiosity than as a pest," while in 1920 it was doing more damage at Coimbatore than both the *Earias* species and the pink boll-worm together. In the Sudan it is more a pest of other crops than cotton, and in the West Indies it is not important. In Australia, however, serious damage is reported. The American boll-worm attacks cotton also in Hawaii, Nyasaland, South Russia, and Annam.

As has been described, the bolls are not only destroyed by the internal feeding of the boll-worms, but also by the external attacks of bugs, amongst which the cotton stainers (*Dysdercus* spp.) and the dusky bugs (*Oxycarenus* spp.) are prominent. The genus *Dysdercus* contains over seventy species, but of these, only twenty-two have been recorded as cotton feeders, though the remaining species should be watched as potential pests. The economic species are widely distributed, in fact, the only cotton areas of importance that are free are Egypt, South Russia, and Mesopotamia; however, the two species that occur in America (*D. suturellus* and *D. albidiventris*) do not occur throughout the cotton belt, being found only in the south-east and south-west regions. *Oxycarenus* is another large genus, and the seven cotton-feeding species have a wide Old World distribution, being especially prominent in Africa; they are also found in Mesopotamia, India, Burma, and Australia.

The cotton leaves support a very large and mixed insect fauna which is very variable as to its economic importance. Some of the most prominent of the leaf feeders, and certainly those most noticed by the cultivators, are the larvae of a number of moths, and amongst these the cotton worm (*Alabama argillacea*, Hübn.) is remarkable for its varied status. It is found practically throughout South and North America and the West Indies, and is probably indigenous to Brazil. In the American cotton belt the severe outbreaks have occurred, either by chance or otherwise, in regular twenty-one-year cycles; such outbreaks were recorded in the years 1783, 1804, 1825, 1846, 1868, 1872,* 1890, and 1911. Before the coming of the boll-weevil this insect was considered one of the worst pests of cotton that claimed the attention of American entomologists, for in bad years it practically denuded the bushes of their leaves, and had generally the appearance of a pest of the deepest dye. The caterpillars were so abundant that they were regularly fed to the turkeys, they were used as food for pigs, and even cats and dogs were observed to feed upon them. But the boll-weevil has somewhat modified the status of this moth, and now the year 1923 will be welcomed by both entomologist and cotton grower, by the one to test a doubtful hypothesis, and by the other as heralding a cotton crop free from any serious boll-weevil attack. The cotton worm has become an indirect, but very real, enemy of the boll-weevil.

* This is the only year in which an outbreak occurred not in accordance with the twenty-one-year sequence.

In the cotton fields, as the season advances, the number of fallen bolls and squares that lie beneath the plants increases, and it is in these fallen bolls that the boll-weevil breeds profusely. Under normal conditions these bolls are well protected from the blazing sun by the mosaic of leaves of the cotton plant above, but if these are removed by man or caterpillar—and the latter is by far the most efficient—then these bolls on the ground and also the lower bolls on the plants, which were also shaded, become heated to such a temperature as is fatal to any boll-weevil grub within. Moreover, without the leaves the crop will mature earlier, and the picking will be complete before the boll-weevil attack has attained its maximum. For in obtaining a good yield under weevil conditions it is chiefly a matter of obtaining an early crop by means of early sowing, by using early maturing varieties of cotton, by thorough cultivation, and by any other method, including the ravages of the cotton worm.

All the pests that have been dealt with are of such a size that the cotton cultivator may readily be aware of their presence in his fields, and he will understand that they are capable of causing grievous harm to the plants; but many of the very important pests are exceedingly small and inconspicuous, and as a rule the cultivator does not see in the swarm of "flies" that are constantly to be seen around the cotton plants, or in the less active and still less obtrusive organisms that remain on the stems and leaves, the real cause of his unhealthy and unproductive plants.

Of these smaller pests the cotton thrips (three spp. of *Heliothrips*) is one of the most important, especially to the grower in the Anglo-Egyptian Sudan, being also found in North and South America, the West Indies, South Europe, India, and Java. The adult insect is a little over 1 mm. in length, and possesses two pairs of beautifully feathered wings; they usually rest in depressions of the leaf, and move about by walking and by jumping, but if disturbed they do fly for small distances, usually circling around the plant. The adults feed by sucking the sap from the leaves, preferably on the upper surface, and beginning on the lower leaves of the cotton plant work upwards, giving the plant a characteristic white or silvery appearance; the leaves eventually wither and fall, and the younger plants are frequently killed. The eggs are laid in an incision made on the undersurface of the leaf; the larvae that hatch are similar to the adults, but do not possess wings, and they damage the plants in a similar way. After a few days the larvæ descend and become quiescent in some crack in the earth, and twelve days later the adult thrips emerges. These insects feed on a great variety of wild plants, and when the cotton is not growing they migrate to these plants and are able to subsist on them until the next cotton season. Thus it is obvious that clean cultivation is a very important check; hoeing exposes the quiescent stages to the fatal heat of the sun, and as moisture hinders their development, heavier watering may be advised. In this latter respect it is interesting to note that infestations are always more severe in those parts of the field that are exposed to any drying wind.

The cotton aphis (*Aphis gossypii*) is another of these small insects of importance. Widely distributed over the world and feeding on a large variety of plants, this aphis occurs in practically all the cotton fields of the world. Its feeding causes a curling and dwarfing of the leaf and malformation of the

plant to a very serious extent. It is preyed on by many other insects, which check it to a far greater degree than any artificial control as yet devised. Both the black and white scale (*Saissetia nigra* and *Hemichionaspis minor*) are of first-class importance, and finally there are two mites which should be mentioned. The cotton woolly mite (*Eriophyes gossypii*), found in the West Indies, India, and the Gold Coast, forms blisters on all the plant structures, except the root, destroying the axillary buds and preventing the development of the all-important lateral shoots. Seeds in an infected area should be disinfected either by a solution of mercury perchloride or by fumigation with carbon bisulphide, so that the spread of the pest may be prevented. The most hopeful method of checking this pest is in the development of a mite-resisting strain of cotton plants, a method that is being investigated in the West Indies. The red spider (*Tetranychus* spp.), of world-wide distribution, is usually found on the underside of the leaf, where it spins a silken web under which it feeds protected from weather and insect enemies. The attacked leaves turn red, wither, and fall; in the south-east regions of the American cotton belt the annual damage is estimated at about 2,000,000 dollars, and in Russia it is suspected of carrying disease.

In this description of the major insect pests of the cotton plant, emphasis has been laid on the importance and efficiency of natural checks and indirect methods of control, which are as a rule more effective in the long run when dealing with large infestations than any carefully conceived mechanical or chemical process. As regards these latter, there are usually insurmountable difficulties in the form of expensive apparatus or supply of material; thus in the case of the boll-weevil it has been found that the best method of posioning beetles is by a thorough application of a fine powder of pure calcium arsenate, but not only have expensive and, as a rule, inefficient machines to be used for the application, but the annual world's output of calcium arsenate is not sufficient to treat the entire American cotton belt during one season. Also, unless care is taken the cultivator spends more on the poison and its application than he gets from his increased output.

In order that these pests may be controlled it is absolutely essential to observe in every detail their life-history, to find out their natural enemies and their food plants; it is then often possible to find some weak spot in their annual cycle, where some small change may be effected and the cycle disrupted.

Many of the cotton pests, while feeding whenever possible on the cotton plant, have alternative food plants of which the Malvaceae are the most important, to which the insects migrate when the cotton crop is over, and in these cases the obvious and ideal method of dealing with the pest is the destruction of all the available food throughout the Winter. Not only must the cotton plants be ploughed up and burned as soon as the picking is over, but all the alternative food plants must similarly be dealt with. This principle has been widely recognized and has resulted in the formation of laws decreeing the destruction of the cotton crop before a certain date. The beneficial result of such a campaign has been well shown in certain of the West Indian islands, where the cotton stainers have been reduced practically to the point of extinction.

The major pests of to-day may be overcome by science or, more probably, by natural means, but wherever cotton is grown we may safely say that some insect will rise from that vast horde of cotton feeders to the status of an important pest. The more man cultivates the world the more is the balance of nature upset. Fresh land is reclaimed, native plants destroyed, cotton is introduced, the insect life finds a new and wholesome food, certain species thrive and become dominant, and the entomologist is faced with a new problem. But there is no need for it to be a baffling problem so long as he studies not only the present major pests of cotton, but also the more numerous minor and potential pests.—Empire Cotton Growing Review, Vol. I., No. 3.

MOULDY ROT OF RUBBER.

The following account of Mouldy Rot of Rubber is taken from a lecture by Mr. F. W. South, published in the *Malayan Tin and Rubber Journal*, Vol. XIII., No. 14 (July 31st, 1924), pp. 852-855 :—

SYMPTOMS OF THE DISEASE.

1. Small black spots about the size of a pin's head appear on the renewing bark at a distance of ¼ to 1 inch above the tapping cut.

2. On these is formed a mould of a light grey colour, dense and well marked.

3. The spots coalesce as the disease progresses, merging into one another to form a band of blackish decayed bark covered by a bright-grey, thick mould consisting mostly of a mixture of two fungi, *Sphaeronema fimbriatum*, the cause of the disease, and *Cephalosporium* sp. mainly living on the dead or dying tissue.

4. The bark then dies right down to the wood and the fungus itself darkens in colour becoming nearly black. At this stage small black bristles may be seen rising through the dark mould. These are best observed by looking along the surface of the bark. They are the necks of small flask-shaped receptacles in which one kind of the spores of the fungus is formed. Wax-like masses of these spores may be seen attached to the protruding necks or bristles. The bristles and the attached mass of spores are visible to the naked eye, but are more easily seen through a hand lens.

5. Eventually the dead bark dries up and falls off exposing diseased and discoloured wood and forming wounds similar to tapping wounds.

The disease first shows to the naked eye from a week to ten days after the actual infection has taken place.

If tapping is continued on a diseased tree without treatment, all the bark of the infected panel may be so badly damaged as to prevent formation of any tappable renewal for many years, if not permanently.

The fungus forms two other kinds of spores in addition to those already referred to as expelled from the small flask-shaped receptacles. These arise from the hyphae forming the grey mould. One form is hyaline and thin walled serving to reproduce the fungus quickly, since it germinates at once in favourable conditions. The other, thick walled and dark coloured, resists drought and carries the fungus through long periods of dry weather, germinating and causing reinfection in wet weather.

CONDITIONS FAVOURING THE GROWTH AND SPREAD OF THE FUNGUS.

The fungus depends for vigorous growth on the presence of much moisture in the surrounding air. Thus it always appears in wet weather and tends to disappear or grow less vigorously in dry weather.

2. Places where night mists are common, *e.g.* Jelebu district and parts of the Muar river valley, are more subject to the disease than other places.

3. On low lying, ill-drained land, such as that around Bandar Maharani in the Muar district of Johore and in the mukims of Sebatu and Sungei Rambai in Malacca, the disease is present almost continuously.

4. The presence of lalang, blukar, numerous rubber seedlings and other forms of dense undergrowth on rubber land keeps the air moist, thus assisting the growth of the fungus.

5. Close planting favours the development of the fungus.

6. Deep tapping renders the bark more liable to the disease.

On small holdings during the worst period of the slump the disease became more prevalent because the trees were severely tapped to compensate in quantity of rubber for the low price obtainable; and also because the holdings through lack of money were allowed to become overgrown with weeds, bush and rubber seedlings. Restriction has resulted in many holdings remaining untapped for one month in three, thus checking the disease. Alternate-day tapping helps to control it.

It has often been noticed that in dry weather the fungus has disappeared entirely after treatment of the diseased trees and has been absent for several months. With the return of rainy weather, however, the disease has reappeared on some of the trees previously attacked. This appears to be due to the presence on the trees of the thick-walled, black spores which are able to survive the dry spell and germinate later if they reach the tapped bark. In the Laboratory these spores germinated after being dried for 3 weeks over calcium chloride.

METHODS OF SPREAD.

The spread of the disease from one locality to another is certainly due mainly to human agency, the spores being carried on the clothes and tapping knives of tapping coolies, Chinese, Javanese, and Banjarese, who move about from kampong to kampong and district to district looking for work.

In the case of the outbreak on the Muar river one or more Javanese tappers in the small holdings there were recognised as having come from the infected area at Kuala Pilah : while at Bruas coolies from Padang Rengas were recognised. On several occasions too it has been found that a holding that has become infected, at some little distance from other infected holdings, is tapped by the same cooly who is working on another holding in the main infected area.

The comparatively rapid spread of the disease in the Seremban district in the earlier days of its occurrence, about 1917, was probably due to the very general employment of Chinese coolies tapping on contract in the District.

It is also noteworthy that in spi e of the prevalence of the disease on small holdings both in Malacca and around Kuala Lumpur very few estates became infected. This is probably because the estates employed Tamil tappers who did not come in contact with the disease. Two other instances in support of this idea may be quoted. On an estate in Malacca trees on a certain field became infected. It was found that the tappers were Malays who tapped their own holdings, which were infected, in the afternoons. On an estate in Perak a few trees became infected beside a path along which passed every day tappers who worked on infected small holdings beyond the estate.

Insects may also serve to carry the spores from tree to tree on their bodies, while during rain storms the light hyaline spores may be carried by the wind and driving rain from infected to healthy trees, thus sometimes carrying the disease from an infected holding to the adjoining trees of an estate.

TREATMENT.

The methods of treatment are rather various but the following procedure can be recommended.

1. Stop tapping all diseased trees in an infected task, or if preferred stop tapping the whole task.

2. Paint all the trees with one of the disinfectant solutions mentioned below, covering the whole renewing surface right down to the tapping cut and including the latex channel. The scrap should be carefully removed before painting and burnt. The diseased trees should be marked.

3. Paint again, after an interval of from 7 to 10 days, all trees showing any signs of the disease.

4. Examine the whole task again after 2 weeks to 20 days and again paint any trees that are not entirely free from signs of the disease.

5. Repeat the examination again after 3 weeks to 30 days.

6. During this period collect all cups, knives and spouts from the tasks and burn all scrap bags. Disinfect the cups, knives and spouts by immersing them over night in the disinfectant solution, or by boiling them for an hour in water.

7. After about 1 month tap again either on a new panel or on a cut 2 inches below the old cut.

On one estate infected trees have been sprayed with the disinfectant from the top of the tapping area to the ground. This has given excellent results, as the disease has not reappeared on trees so treated, while not only is there a saving in the quantity of the solution used, but the solution itself penetrates more thoroughly into the cracks in the bark than when applied with a brush or a pounded piece of bamboo.

Suitable mixtures for treating this disease are 20% Agrisol, plain or coloured; 20% Brunolinum plantarium, in water ; and 25% tar, 25% Brunolinum and 50% water containing 1 lb. of soap in each 4 gallons of mixture. Other disinfectants that can be used are numerous; mention may be made of Salomia, Novolineum, Paterlineum, Carbolineum plantarium and Barkol.

Accounts of treatment will be found in the *Malayan Agricultural Journal*, Vol. VIII. No. 2, Vol. IX. Nos. 3 and 4 and Vol. XI. No. 2.

CONTROL.

1. Be careful to take away the knives of new tappers engaged in infected areas, issuing new knives.

2. Where there are infected small holdings on the boundary, paint all the trees three rows deep along the boundary once in 10 days with one of the mixtures already mentioned, or leave the trees untapped.

3. Keep a careful watch for and treat promptly any case found.

4. Remember that even when the disease has completely disappeared in fine weather, it may very possibly return when the weather becomes wet.

5. Attend to drainage, thinning out, or clearing the land from undergrowth, if necessary.

The disease is easily and cheaply treated and controlled and, therefore, need cause no alarm. The Department has published much information concerning it of late and has given numerous demonstrations of its symptoms and treatment ; this has been done, not in order to alarm planters, but to make known to all nationalities the appearance of the disease and the ease with which it can be prevented from doing serious damage. Its eradication appears to be outside the realm of practical politics, as is even the prevention of its ultimate spread to all areas containing poor rubber growing under bad conditions. There is no means of stopping the movements of tappers from one small holding to another, so that clearly there is every prospect of the disease finally becoming very general in its distribution. This need not, however, cause alarm, since it is so easily treated and even kept out of estates employing a settled labour force.

A PRELIMINARY NOTE ON A NEW BARK DISEASE OF HEVEA.

A. THOMPSON.

The renewing bark of rubber trees has been damaged recently by a fungus growth, similar to one which formerly was observed to grow superficially on young bark at the corner of a tapping panel, where it formed a patch of white mycelium from 1-3 inches in diameter. This fungus was never observed to have penetrated the bark and disappeared normally by scaling of the bark.

At the end of 1922 and the beginning of 1923 several specimens of bark attacked by this fungus were received from various parts of the country, and in a few instances it was noticed that slight penetration had occurred.

During the last quarter of 1923 the fungus again became active, and specimens of the attacked bark showed that damage was being done, as in the majority of cases the fungus had penetrated to the wood, and caused the bark to rot.

SYMPTOMS.

One of the first signs of the present attack is a small fan of mycelium $\frac{1}{4}$-$\frac{1}{2}$ an inch above the tapping cut, later forming a small plate of white mycelium, with a mycelial fan at the edges. A number of these plates may be formed, some at the corners and others in the centre, of the tapping

cut. Later on some of these plates fuse together into several patches which may be from 6-8 inches in diameter. The disease can be seen from a considerable distance as these patches are conspicuous, being white at the edges where the fan-like mycelium creeps over the bark, and whitish-grey in the centre where the bark is rotted.

Trees which were opened up for tapping on January 1st showed the disease after 3 weeks' daily tapping The disease, therefore, can become evident three weeks after infection and possibly sooner.

Little is known as yet about the method of infection, as inoculations of the fungus into the bark of healthy trees have so far produced no result.

CONTROL.

Up to the present the disease has proved amenable to treatment by putting the affected trees out of tapping and painting them with a 10-15% solution of Agrisol or Brunolinum plantarium, for two applications with 7 days' interval between. All the trees in the affected area should be painted with a disinfectant, *e.g.*, 5% Izal, 10-15% Agrisol, Brunolinum or Brunolinum plantarium. As a precautionary measure it would be advisable to sterilise the tapping knives of the coolies tapping the affected plots.

The disease is not as yet very serious, as only a few trees are attacked at the same time. The fungus appears to have been educated up to definite parasitism in a comparatively short space of time, and for fear of further developments it should be taken in hand at once.—Malayan Agricultural Journal, Vol. XII., Nos. 6 and 7.

TO CONTROL "CLUB-ROOT" OF CABBAGE.

C. P. DARNELL-SMITH,

Director of Botanic Gardens and Biologist.

Club-root of cabbage, cauliflower, turnip, radish, &c., is due to a "slime-mould" (Myxomycete) known as *Plasmodiophora brassicae.* Infection may take place in the seed-bed, and in such cases good control has been obtained by watering the seedlings with a solution made up of 1 ounce of corrosive sublimate to 2 gallons of water. Corrosive sublimate is *extremely poisonous* and must be handled with care and kept out of the reach of children.

Where infection takes place in the field the following measures are recommended :—

1. Grow susceptible crops on new land or on land that has been rotated with other crops.

2. Apply fresh unslaked lime at the rate of 150 bushels per acre.

3. Destroy by burning all refuse from a previous susceptible crop.—The Agricultural Gazette of New South Wales, Vol. XXXV., Part 7.

SOILS AND MANURES.

MANURE AND SOIL CONSIDERATIONS.

Of all the aspects of the art of manuring, the consideration of the soil is probably the most important and least thought of. It should be fully realised that the results obtained with a particular manure, on a particular soil, and under particular conditions, will not necessarily be obtained under any other conditions in this or in any other country. It is certain that agricultural progression has been hindered by the apparent inability of some agricultural experimenters to grasp this fact.

From the chemical composition of the soil little information of value can be obtained except in so far as concerns lime deficiency. The physical nature of the soil is a much more valuable factor, from which certain fairly useful indications may be derived, but even these are not always reliable. It is usually considered that a clay soil, because of its composition, will contain sufficient potash for the use of plants. That this is not always so has been clearly demonstrated in many experiments, where it has been shown that on certain clays potash may even be the determining factor of fertility. Excellent results have been obtained by using high-grade basic slag on neglected grass land on heavy clay soils. Such soils contain sufficient moisture to assist in the solution of the insoluble phosphates of the slag. On soils containing a sufficiency of lime one may expect to obtain the best results from applications of superphosphate, which manure requires lime in the soil to precipitate its phosphate. As a source of phosphoric acid for general use a mixture of superphosphate and crushed bones or bone dust is recommended, but the cost of the last is now almost prohibitive. From such a combination one obtains the quick action of the superphosphate and the more lasting action of the crushed or ground bones.

On practically all light soils it is essential to supply potash and phosphates, and the most economic way to supply nitrogen on such soils is in organic forms, such as in green manure or in blood and bone.

OTHER CONSIDERATIONS.

There are some aspects of economic manuring which are never sufficiently taken into account. One of the most important of these is the comparison of costs of the various sources of the manures. With this should be coupled the questions of grade and condition. Other things being equal, the highest grade manure is more economic than its less concentrated competitor, because it entails less expense for labour and cartage. Especially with regard to the less soluble manures, the fineness of grinding is very important, and in mixing manures care has to be taken that no loss occurs in the process, and that the resulting mixture will be suitable for handling and sowing.

A further point of interest is that one source of fertilising principle may produce better effects upon a particular crop than another. For example, sulphate of potash is a better source of potash for potatos than either muriate of potash or kainit.

On the other hand, kainit will give better results on mangels and on old pasture because of its content of common salt. In some experiments bone manures as a source of phosphoric acid and nitrogen have been found to give crops of better quality than do other sources of these constituents.

SYSTEMATIC MANURING.

In conclusion, a study of the subject of manuring leads to the belief that there are essential points which each and every agriculturist must consider very carefully. The immense practical value of leguminous crops as a cheap source of nitrogen should never be overlooked. By a carefully planned rotation of crops the use of expensive artificial manures may be reduced. While the agricultural advisor is of the greatest assistance by indicating the method of manuring which is likely to prove most useful, the best advice that can be given is to experiment for one's self. Such home trials are not difficult, and if properly organised, are not expensive, and their value is immeasurable.

In these experiments the co-operation of the agricultural advisor is invaluable.

It must be always advocated that the use of manures should be based on a definite system. Such a basal system would aim at maintaining the fertility of a good soil or at securing fertility in a neglected soil, whilst at the same time it would ensure that the soil as a medium of production always contains a sufficiency of the various fertilising elements in a form readily available for the crops of the rotation. Cases of emergency would be met by the judicious use of top-dressing or special applications according to requirements. Such a system, if adopted, would not only be more productive, but much more economic than the haphazard methods now commonly used.—The Malayan Tin and Rubber Journal, Vol. XIII., No. 13.

WHEN MANURING FRUIT-TREES.

W. LE GAY BRERETON,

Assistant Fruit Expert.

"I am putting stable manure on my orchard this year instead of bone and blood. Should it be spread around the trees, say a foot from the trunks to the circumference of the branches, or would it be better to spread it in the ways between the rows of trees ?"

In response to the foregoing, it was stated that the manure should be kept away from the trunks of the trees, as if it was allowed to come into close contact with them it might induce collar rot. It should be spread well out into the rows and dug or ploughed under.—Agricultural Gazette of New South Wales, Vol. XXXV., Part 4.

AGRICULTURAL METEOROLOGY.

THE ORGANIZATION OF AGRICULTURAL METEOROLOGY.

AGRICULTURAL ECOLOGY IN GERMANY.

Prof. Dr. P. HOLDEFLEISS.

University of Halle a/S.

The connection of meteorology and climatology with agriculture has been recognised from remotest antiquity; further, that the weather affects the results of farming, agriculture and stock-keeping is very well known and the need has always been felt of finding some explanation of the correlation not only in the interest on individual agriculturists, but also in order that this knowledge may be employed for the purpose of insuring to the world at large a more certain supply of the produce of the land. Whenever the opportunity presented itself, as for instance, in 1878 at Cassel, and in 1900 at Hamburg, where interested persons were asked to give their opinions, they insistently and unanimously expressed their desire to explain and turn to account the above-mentioned relations, but until recently, the path to be followed could not be agreed upon. The question could only be adequately handled by the professional meteorologists who, however, were engaged in establishing the first principles of their own science, while meteorology was an unknown field both to the practical and the scientific agriculturist. Lack of meteorological knowledge then, as until quite recently, obscured the view, even of the circle of persons most directly interested. A prominent position was occupied in all these discussions by weather forecasting, this being the only means by which meteorologists believed they could render useful service to agriculture just as they assisted the sailor by timely warnings of an imminent storm. The possibility of short-time weather forecasting had been discovered, but even when the prophesies were correct, they did not sufficiently prove the utility of meteorology to agriculture nor satisfy the continual need, to a certain extent an elementary one, of forecasts that prophesied the weather longer in advance, telling the agriculturist what to expect many days, or possibly, several months beforehand, or even during a considerable part of the agricultural year. The ordinary forecasts for one day are by no means useless to the farmer who, provided the information is reliable, can often avoid disappointment and injury by following the advice of the meteorologist. Such short notice can, however, only affect a few important questions and usually only applies to the work of the day on average-sized farms, whereas it is of no use in large undertakings which require decisions as to the operations of a whole year. For these, long term weather-forecasting, if feasible, would be of incalculable advantage. Owing to the importance of the matter, very large prizes have long been offered in the United States of North America, to anyone succeeding in prophesying the weather correctly for a whole year. Several unprofessional persons in Germany have turned their attention to this problem (Rud. Falb. Andreas Voss, in Berlin and Landgerichtsrat Hinselmann at Hildesheim) and have gained for themselves a by no means small following, which clearly proves how great is the need. Unfortunately, these amateur meteorologists deal with more or less correct

ideas in an inaccurate and unscientific manner, so that new unavcidable errors necessarily arise. Further, the statements of the results obtained are often subjective and untrustworthy. To avoid such errors is the main issue and here it is necessary for agriculture in general, and agricultural meteorology in particular, to work together with pure meteorology. Is is quite impossible for the former branches of science to be independent of the latter.

Agriculture must indicate the direction the work is to take and state the object to be attained, while pure meteorology, on its side, must use the means at its disposal and attack the difficult problem of long-term weather-forecasting. The co-operation of the pure meteorologist is necessary to agriculture in order to guarantee the correctness of the observations which render it possible to know the climate and form an opinion on crop conditions and growth.

The importance and the direct practical utility of regularly recording temperature, rainfall, overcast weather, the direction and force of winds, and possibly atmospheric moisture, have already been demonstrated and will be recognised by continually increasing circles of agriculturists,

There, however, still remain difficulties connected with the right installation and use of the apparatus, the correct estimation and interpretation of the results obtained, which need further scientific and technical research, while a revision of aim in accordance with the requirements of the agriculturists is often necessary.

In addition to forecasting the weather, agricultural meteorology has also the important task of making and working up observations explaining already existing phenomena. A knowledge of the climate makes it possible to foretell the weather to a certain extent. The averages that have been observed give a range of variation that affords useful assistance in deciding the direction of extensive agricultural operations. Whether sugar-beets, maize, lucerne, or more productive but less robust varieties of wheat should be cultivated can only be known by reference to the weather records. This work, however, belongs to the narrower field of agricultural meteorology which has already been touched upon, and even more or less exhaustively treated, in connection with agriculture, horticulture and stock-breeding, although its importance has never been sufficiently recognised and brought forward; indeed as compared with soil science, agricultural meteorology, although strictly speaking of paramount importance, has always been treated as a matter of secondary interest.

Many small and even large and far-reaching mistakes and disappointments have been due to inadequate knowledge of climatic conditions. In all agricultural and field experiments, in the agricultural researches which are recognised to be of ever increasing importance, knowledge of the climatic factors is of especial moment and may be regarded as indispensable. Here, as we have already stated, pure meteorology is required in order to insure the accuracy of the data recorded.

Phenological observation is a great help to knowledge of climate, especially from the agricultural standpoint, for by this means, a record is kept of the different phases and growth stages of plant development.

The course of vegetation registers faithfully the sum of the results produced by the weather factors and is a more trustworthy evidence than even meteorological observation. The connection between plant development and weather has not been rendered completely clear, but phenology has done signal service in establishing the characters of the average climate and the weather conditions of a single year. The founders of this science, in the first place, Hoffmann (Giessen) and later G. Drude (Dresden) and Ihne (Darmstadt) began by regarding the plants selected for observation from the botanical standpoint, but afterwards they added rye, fruit-trees

and vines, etc., to their list, and studied these from the point of view of the agriculturist and the horticulturist. The "Biologische Reichanstalt fur Land und Forstwirtschaft" has lately started an extensive phenological service directed chiefly to the observation of agricultural and farm crops, garden plants and fruit-trees, special attention being given to plant-diseases whether caused by fungi or animals. It is not to be expected that all the observation Stations will send answers to the large number of questions submitted to them, but if they supply only a certain amount of information on the different heads, the data can be worked up with useful results at the Central Station. Therefore the observer must not be alarmed at the length of the questionnaire he receives. A few accurate, careful answers are of much more value than a number of unreliable statements. If the undertaking succeeds fairly well a great deal of material will be collected that will not only prove very useful for scientific and practical work, but will also afford results beneficial to the world at large.

The following is a list of the subjects falling within the scope of agricultural meteorology. They are not arranged in any special order.

In the first place come :—

1. Long-term weather-forecasting. Prophecies for term of agricultural operations.

How far weather conditions affect :—

2. True and false mildew ;
3. Rust-fungi ;
4. Smut-fungi ;
5. Aphides ;
6. Spread of wheat varieties resistant and non-resistant to cold ;
7. Range of maize cultivation for grain ;
8. Limits of lucerne cultivation ;
9. Conditions of clover and lucerne cultivation ;
10. Conditions of grass seed cultivation ;
11. Rotation in the case of cereals, special kinds of oat and potatos ;
12. Sugar content of beets ;
13. Quality of tobacco ;
14. ,, ,, wines ;
15. ,, ,, hops ;
16. ,, ,, flax ;
17. Cultivation of aromatic plants, caraways, fennel, peppermint ;
18. Cultivation of poppies for seed, oil, or opium ;
19. Albumen and starch content of wheats ;
20. Albumen and starch content of barleys ;
21. Oil content of colza and flax ;
22. Quality of mustard ;
23. Fungus diseases of peas, especially *Ascochyta* ;
24. Fungus diseases of lupins ;
25. Determination of date of sowing, especially of cereals, beets, potatos.

The number of these items could well be enlarged.

The satisfactory answering of these questions would do much to increase and insure agricultural crop returns. If once the factors influencing plant growth were determined, it would be possible in most cases to strengthen the favourable influences and to prevent or mitigate the injury caused by untoward conditions. This is the real way in which meteorology can help agriculture, which is indebted to pure meteorology and phenology for the discovery of first principles and the collection of much valuable material.

It is the work of agricultural science to give the impetus to important research and to collect and distribute the material obtained, as by no other agency could scientific and agricultural principles be sufficiently combined. Meteorology by itself could not deal with the agricultural side of the above-mentioned questions, neither could it cope with them from the botanical, zoological, biological or chemical standpoint. Agricultural Meteorology is a branch of agricultural science which, like the latter, is in need of several ancillary sciences. These forfeit nothing of their importance ; on the contrary, their utility and field of work is enlarged, although the application of their discoveries to practical agriculture lies outside their province.

* * * *

As a result of the resolutions passed by the International Institute of Agriculture in Rome, a Sub-Committee has been appointed by the Reichs Ministry of Food and Agriculture for the purpose of promoting the interests of Agricultural Meteorology. In this Sub-Committee, pure Meteorology, the "Biologische Reichsanstalt fur Land und Forstwirtschaft" (Reich's Biological Institute for Agriculture and Forestry), the "Landes Anstalten fur Gewasserkunde" and the "Landwirtschaftswissenschaft" (Institutes of Hydraulics and of Agricultural Science) are represented. The following points were discussed :

1. The creation of a Central Institute for work connected with Agricultural Meteorology is not advisable. In future, this work is to be decentralised and entrusted to the Institutes of Agriculture and Science connected with the Universities and High Schools, the "Biologische Reichsanstalt fur Land und Forstwirtschaft" (Reich's Biological Institute for Agriculture and Forestry), the Forestry Schools, the Gardening High Schools, the Meteorological Institutes and the Hydrological Institutes.

The assistance of the Statistical Departments is much desired.

2. The mapping of the territory from the standpoint of agricultural meteorology is to be extended.

3. The "Biologische Reichsanstalt fur Land und Forstwirtschaft" has undertaken to collect and work up data referring to agricultural phenology with the object of rendering statistics a more useful and reliable basis upon which to foretell crop yield.

4. It is always being more fully recognised that the most important contribution that pure meteorology can make to agricultural meteorology consists in predicting the weather for longer periods in advance. It is not so much a question of a detailed forecast as of giving the broad outlines of the kind of weather to be expected.

5. The "Landesanstalt fur Gewasserkunde" (Hydraulics Institute) is devoting its attention chiefly to the question of evaporation which, as is well known, is a matter of great importance to the life-functions of agricultural crops and domestic animals.

Respecting the wish expressed that suggestions should be made to the International Institute of Agriculture as to the most appropriate means of collecting data referring to the various growth stages of the different agricultural crop plants and the yields obtained, as well as information concerning the meteorological conditions prevailing during the period of development, we may state that all this work comes within the special sphere of the "Biologischen Reichsanstalt" assisted by the Stations for Reporting Plant Diseases. It is however advisable that this annual report should (after its discussion by the Commission of Agricultural Meteorology) be forwarded by the Reichs Minister for Food and Agriculture (Reichsminister fur Ernahrung und Landwirtschaft) to the International Institute of Agriculture.—International Review of the Science and Practice of Agriculture, Vol. II., No. 2.

DAIRY FARMING.

DAIRY FARM BUILDINGS, FITTINGS AND EQUIPMENT: THEIR RELATION TO CLEAN MILK PRODUCTION.

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The success which has attended the clean milk competitions promoted by county and other authorities and supported by the Ministry of Agriculture, has resulted in an increasing appreciation amongst dairy farmers of the necessity for more hygienic methods in the production and handling of milk at the farm.

It has been shown conclusively that success in clean milk production rests largely upon the quality of the labour employed and the method practised. These, however, are not the only considerations, since it is certain that good buildings and well-chosen equipment render material assistance in the production of milk of the highest purity. Dark, ill-ventilated and insanitary cowsheds, for instance, are largely responsible for the spread of respiratory and udder diseases amongst housed cattle, which are deprived of the known benefits of fresh air and sunlight in destroying disease-producing and other organisms. The proper housing of the animals is of particular importance in those districts where climatic conditions compel stall feeding for many months of the year. Further, the amount of time and labour which must be expended in keeping the buildings and cattle clean is very largely reduced in well-designed and equipped byres.

Not the least point of importance is the psychological effect upon the workers who, serving under insanitary conditions, can hardly be expected to give of their best.

The great majority of dairy farmers and landlords will be concerned not with the erection of entirely new buildings, but with the improvement of those which exist. This article is, therefore, designed to apply chiefly to the latter.

The Cowshed: *Ventilation.*—It becomes abundantly evident in making inspections of existing cowsheds that ventilation has not in the past been a prime consideration in their construction. There is still a widespread prejudice in favour of a system, or lack of system, of ventilation, which allows the farmer to keep his cows "warm." Although it is certainly very undesirable that cows shall be exposed to draughts, the prevalent idea that the milk yield of the animals is increased in proportion to increases in temperature has been shown to be a fallacy.

Elaborate systems of ventilation which depend for their efficiency upon constant adjustments of inlets and outlets are hardly likely to be successful.

Efficient ventilation can be secured by the correct disposal of windows of the right type, which also serve to admit the light which is so necessary

and so often absent. Those windows which are hinged at the bottom and open inwards are desirable, since they supply abundant fresh air and do not allow draughts to reach the cows. The old system of air bricks under the eaves is excellent. The raising of the ridge tiles at intervals provides an effective outlet for foul air in the absence of an extraction cowl.

Although the American system of housing stock and all the fodder under one roof does not recommend itself to English practice, many cowsheds have a loft above. In these cases it is often necessary to provide an air shaft with an extraction cowl to the apex of the roof.

Air Space.—It is not possible to dismiss the question of ventilation without a reference to air space. In spite of the fact that an efficient ventilating system can be made to remedy defects of air space, it is desirable that in making alterations to cowsheds every endeavour should be made to approach the minimum of 600 cubic feet per cow for large animals and 500 cubic feet for small ones. In considering air space the question of floor area is important, since height 14 ft. is of little use. It is often wise when making internal alterations to sacrifice the use of an existing stall to considerations of air space.

Light.—Abundant light is essential and cannot be too freely provided. The position of windows should be so arranged that plenty of light falls on the hindquarters of the cows. The construction of the walls behind the cows sometimes restricts the amount of window space, and in these cases, when there is no loft above, existing tiles may be replaced by patches of Bridgwater glass tiles. Every effort should be made to provide at least three square feet of window space per cow.

Artificial Light.—The great majority of farms have not the advantage of a public lighting service, and the provision of good artificial light has been a matter of some difficulty. The old type of hurricane lamp is not adequate and requires constant attention. Incandescent petrol vapour lamps, which are economical and give ample light, are now specially made for use on farms.

Floors, Walls and Roofs.—In making interior alterations to the cowshed, the question of ease in cleaning must be kept in mind. Unnecessary angles and corners should be avoided and smooth, plain surfaces aimed at. The use of cement concrete has solved this difficulty on a large number of farms. It is relatively cheap, easily laid and durable. Practically any existing floor may be greatly improved by laying concrete to a depth of 6 to 7 in.

The practical farmer will probably question the wisdom of the use of concrete for cow stalls, on the ground that it is cold, and liable to cause udder chills. The objection is, however, not borne out in practice, since the amount of udder trouble on the large number of farms where concrete has been used and where clean milking is practised is undoubtedly less than under ordinary circumstances.

Walls—Rough stone or brick walls can also be covered with a thin layer of cement, which greatly facilitates cleaning and prevents the accumulation of dust. Even wooden walls can be faced on the inside with cement to a height of about 4 ft. 6 in. The remainder of the walls as well as

the roof can be kept in a sanitary condition by the frequent use of the lime wash spray. This latter is a cheap and effective way of disinfecting and keeping the sheds clean, and its use should be encouraged to the fullest extent.

Standings.—The dimensions and fittings of the standings are amongst the things which have the most important and direct bearing on the quality of the milk produced, and much unnecessary expenditure has resulted from failure to grasp the fact that raised standings are provided solely for the purpose of keeping the cows clean. In order that this may be done, the length of the standing from the edge of the manger to the edge of the gutter must not be more than 5 ft. or 5 ft. 6 in. for large cows like Shorthorns and Friesians, and 4 ft. 6 in. or 5 ft. 3 in. for smaller cows like Jerseys, depending in each case on the types of neck fastening adopted.

That the comfort of the animals may not be sacrificed in a space apparently so short, it is essential that the manger shall be of the right construction. The height in front must not be greater than 12 in., and the width neither less than 2 ft. 6 in. nor more than 3 ft. The former width is necessary in order that the cow may rest her head on the manger, but it must, obviously, not be so great as to allow the cow to step forward and so foul the standing. In sheds where there is a double row of cows, head to head, or where there is a feeding passage, it is often necessary and important to provide a rail behind the mangers to keep the cows back. Existing mangers may usually be made to conform to this plan by dropping them to the floor level. Glazed half-pipes make very good mangers when set in concrete.

When making new mangers it is important to provide drainage for flushing them at intervals with water. Mangers may be made in concrete for each cow separately, or one long manger may be provided with special galvanised iron partitions, which can be swung out of the way when cleaning.

Height of Standing.—Much of the usefulness of raised standings is lost unless they are sufficiently high, and 10 in. should be regarded as a minimum from the bottom of the dung channel to the level of the standing. Any less depth of gutter than this is very liable to prove inadequate for keeping the cows free from their excreta. There should always be a fall of about 1 in. from the manger to the gutter. The smooth surface of the standing should be provided with shallow herringbone grooves which encourage drainage and give a foothold for the cows.

Width of Gutter.—The depth of the gutter in front must be 10 in. and 4 in. at the back, so that splashes may be arrested. To carry off the liquid part of the excreta the writer considers that a groove should be provided at the shallow side to which there should be a slight fall from the deeper side.

No gutter should be less than 18 in. wide and 24 in. is preferable. This width allows of the free use of brush and shovel in cleaning and encourages cows to step into it instead of attempting to step over, at the risk of slipping on the edge of the standing.

Total Length of the Stall.—The total length of each stall works out at from 7 ft. 6 in. to 8 ft. from the back of the manger to the edge of the gutter. Any attempt to lengthen the standings to more than 5 ft. 6 in., must result in failure to keep the cows clean. Width of manger, on which the cow's comfort so largely depends, should not be sacrificed to the width of the passages behind or in front of the cow.

Partitions.—Where space permits it is better that cows should stand separately rather than in pairs or in one unbroken row. In double stalls one animal is very liable to foul the bed of the other, and injuries to the udder are not infrequently caused by one cow treading on its neighbour. Wooden partitions are not desirable, and may be replaced economically by modern sanitary tubular fittings ; these are durable and relatively inexpensive.

Methods of Tethering.—It is a matter of some difficulty so to tether the cows that they have sufficient freedom for comfort and yet are prevented from stepping forwards and fouling the standing, or backwards, and slipping into the gutter.

Perhaps the most effective method is the use of the galvanised iron stanchions lined with wood, which are supplied by English and Canadian firms. These give relative freedom of movement but do not allow the cows to step backwards or forwards. They have the additional advantage of being easily opened and closed, so that the time lost in securing the cows for milking is reduced to a minimum. Further, some types can be so adjusted that a stall of standard length can be made to accommodate cows of different lengths. This alignment device is very useful with a herd of cattle of different sizes.

Water supply, Drainage and Disposal of Manure.—An abundant supply of water laid on to the cowsheds is both an advantage and a necessity, since a considerable quantity of water is needed for washing the sheds and the cows.

A tank for liquid manure would be valuable addition to many dairy farms, and in order that this valuable fertiliser may not be unduly diluted with the water used for washing, an arrangement should be made to divert the highly diluted washings to the general drainage system. This may be effected by a two-way sluice which can be opened or closed as the occasion demands. The liquid manure tank and manure clamp should be at a reasonable distance from the cowshed.

Much time and labour can be saved in cleaning out and feeding by the fitting of carriers running on an overhead rail from the cowshed to the fodder store and manure clamp.

Cows' Drinking Water.—An abundant supply of drinking water, which is available at all times, is of material advantage. Cows in milk require large quantities of water, and it is obviously better that they should be able to drink when they want to do so rather than wait for a fixed hour of watering. A separate small trough for each cow is the ideal arrangement, as the danger of the spread of colds, etc., from cow to cow by water is eliminated. Such troughs are made, as standard fittings by firms which specialise in cowshed fittings.

If this arrangement is not possible a concrete trough, running the length of the shed and immediately behind the mangers, may be installed. An outlet to permit of regular cleaning should be provided.

Washing of Hands.—Facilities for the washing of the milker's hands before the milking of each cow must be provided. All that is really necessary is a tap, a pail of water, soap and clean towel. A hand basin near the milk tip is an admirable arrangement as each milker can then wash his hands before returning to milk the next cow.

Equipment Used for milking.—The washing of the cows is made very much easier if the hair on the flanks and udders is kept short. An ordinary pair of hand clippers should, therefore, form a part of the equipment of every dairy farm.

Milking Pails.—Because of the great reduction in the amount of visible dirt which is found in milk taken into covered or domed pails, these are coming into much more general use. There are many types of such pails on the market, but the essential feature is a small opening measuring about 7 in. by 5 in., which is set as nearly vertical as is practicable. Every part of the interior of the pail must be readily accessible for cleaning, and those pails which are free from seams and crevices should be chosen. In order to facilitate cleaning some types of pail have the domed top detachable. All covered pails may be tared to act as weighing pails by adding lumps of solder to the bottom ; this procedure avoids the necessity of pouring milk from the milking to the weighing pail.

Milking Stools.— The usual type of wooden milking stool requires constant attention if it is to be kept clean, and is liable to split if sterilised by steam. These may now be replaced by an aluminium stool which is easily cleaned and may be safely sterilised by steam.

The Milk Room.—In view of the benefits of refrigeration in prolonging the keeping qualities of milk all modern dairy farms are now equipped with facilities for cooling the milk. This should be carried out in a small building reserved solely for the purpose. Unless it can be separated from the cowshed by a sound wall the milk room should not be under the same roof as the cowshed. Nevertheless, it should not be at such a distance from the cowshed or milking shed as to constitute a tax on time and labour in carrying the milk. Care should be taken to avoid any position which is exposed to such sources of dust as the stack yard or food cutting and mixing barns.

There is the same necessity for ample light and ventilation in the milk room as in the cowshed, and at least one window should give a good view of the cooler without the necessity for entering the room.

Floor and Walls:—The floors and walls must both be constructed of material such as cement, which can readily be washed. If the whole of the walls are not cemented, the part immediately behind the cooler should be cemented to the full height of the wall, and the remainder carried to a height of 4 ft. 6 in. The ceiling should be flat and easily cleaned. All drainage should be carried to the outside, and on no account should inside traps be fitted.

Outside Receiving Tank:—Traffic in and out of the dairy should be as little as possible. An outside receiving tank with a hinged cover and connected by a short length of movable piping to the strainer inside will avoid the necessity for entering the dairy with each pail of milk. The tank is approached by two or three brick or cement steps, and is protected at the sides and above by a small gable.

Dairy Equipment : *The Cooler*:—Since the cooler is one of the most difficult pieces of dairy farm equipment to keep really clean, care should be exercised in its selection.

Those coolers in which the corrugations are so close together as to render cleaning difficult should be avoided. Many coolers are now made with detachable metal covers, which prevent the contamination of the milk from the air. The movable metal strainer which fits into the top trough of the cooler is unnecessary and is difficult to clean.

The Strainer:—Straining of the milk is a necessity even on those farms on which great care is taken to exclude visible dirt. Nothing has yet been found which is better than good cotton-wool discs. These have the merit

of cheapness, and can be discarded after each milking. Filter cloths are also good, but there is always the danger that they may escape efficient washing and sterilisation.

Churns:—The type and construction of the railway churn are matters of great importance, since many hours are often occupied by the carriage of milk by rail. Ventilation holes have been shown to be not only unnecessary but undesirable, since they permit contamination of the milk by dust and rain.

The ten or twelve gallon churn is preferable to the seventeen gallon churn, as they are much more accessible for cleaning purposes and take up less space in transit, particularly when the handles are set vertically instead of horizontally. Churns with no seams are now upon the market, and still further réduce the labour of cleaning. Insulated churns, which keep the milk cool upon its journey, can also be obtained, and it may be that there is a future for this type of churn.

The Sterilising Room.—Unsterile dairy utensils of all kinds are probably as much responsible for the premature souring of milk as the contamination received during milking and subsequent handling. This has been realised by many farmers who are now installing sterilising equipment of various types. If possible the washing up and sterilising should be done in a small separate room which may be under the same roof, but ought to be separated from the dairy.

Simple Steam Steriliser.—For small herds, up to 15 cows, the simple steam steriliser is an economical and efficient means of sterilising the utensils. In this apparatus steam is generated by two Primus oil stoves from a shallow pail of water which is provided with an insulated cover fitted with a short pipe acting as a steam duct, which is used for sterilising churns. This cover is replaced by a galvanised iron steaming box for sterilising the cooler and the rest of the utensils. Mr. Wilks, of Bewdley, Worcestershire, finds that with this apparatus he can sterilise the utensils necessary for a herd of from 20 to 25 cows at a cost of 3*s*. per week for fuel.

The Converted Farm Copper.—The ordinary farm copper may also be used successfully for sterilising purposes. A hole is bored in the existing lid and a short length of 2-in. piping inserted. This serves for steaming churns and pail. For sterilising the rest of the utensils the lid is replaced by a galvanised iron tank with a perforated bottom. The copper is filled about one-third full with water, which must be kept vigorously boiling throughout the steaming process.

A simple and effective steaming outfit at a small cost has recently been put on the market. It consists of a boiler, which yields 35 gallons of hot water for washing up, in addition to the necessary steam, and a large galvanised iron tank, fitted with a thermometer, for steaming churns, pails, cooler, etc.

Pressure Boilers.—Many firms make excellent small-pressure boilers, which are necessary for the larger farms. If possible the boiler should be in a small separate shed in order to avoid the dust of stoking. Accompanying these are steaming chests in galvanised iron on the floor of which there is a wooden rack which permits of drainage. A tank measuring 4 ft. 6 in. by 2 ft. 6 in. by 2 ft. 9 in. should provide the necessary accommodation for the utensils required for a herd of as many as sixty cows.

Whatever method of raising steam is chosen, it is necessary to see that the temperature is controlled by the use of a thermometer. For efficient sterilisation a temperature of 210 deg. F., maintained for fifteen minutes, should be aimed at. Hot and cold water troughs are necessary for washing purposes, and are preferably made in galvanised iron. Wooden tanks are not satisfactory, as they are difficult to clean and impossible to sterilise.—The Journal of the Ministry of Agriculture, Vol. XXXI., No. 4.

OIL.

VETIVER OIL.

C. D. V. GEORGI.

Vetiver oil, an essential oil, is obtained by the distillation of the roots of the vetiver plant. This plant is a perennial grass, belonging to the same Natural Order—Gramineae—as citronella grass and lemon grass, in which the leaves contain the essential oil. In the case of vetiver it is interesting to note that the leaves are odourless, the roots being the only part of this plant which yield an oil on distillation.

It is thought that the publication of the results of investigations carried out recently by the Department of Agriculture will be of interest in spite of the fact that there is only a very limited demand for this oil.

The supply of roots for the experiments was obtained from the Government Experimental Plantation, Serdang, where small areas of this crop are under cultivation.

The roots have been distilled to determine the yield of oil and samples of the oil have also been forwarded to the Malay States Information Agency, London, for valuation.

NAME OF GRASS.

Vetiver grass is known botanically as *Vetiveria zizanioides*, Stapf.

This grass is but little known in this country; in India, where it is found widely distributed and where the dried roots are used for a variety of purposes, it is known as *Cus-Cus* or *Khas-Khas*. The dried roots are made into baskets and mats (chicks), the latter being hung on verandahs and moistened with water in hot weather, thus perfuming the atmosphere. Bundles of the roots are also placed between clothes stored in wardrobes or boxes, imparting to the clothes the odour of the essential oil, which in its diluted state resembles sandal wood.

In Java there is also a trade in the dried roots, which are known as *akar wangi*, signifying aromatic root.

Vetiver is also cultivated in Reunion; the root is distilled locally, and the oil exported to Europe.

CULTIVATION OF GRASS.

The grass is propagated by root division and appears to flourish best in a light soil, which favours root development. In India, where this plant occurs wild, it is found principally along the banks of rivers and in rich marsh land.

The plant will not thrive under shade, while it is said that root development is stimulated by frequent cutting of the grass.

It has been found that the oil content increases up to the time of flowering, so that if the roots are required for distillation they should be harvested just before this time.

EXTRACTION OF OIL.

The roots are dug up, separated from the stems and washed in running water to remove adhering stones and soil, and then steam-distilled. On account of the low volatility of this oil the distillation is lengthy, requiring several hours to complete. In the investigations carried out in the Department it was found that a period of about 10 hours was required to complete the distillation of a batch of roots.

YIELD OF OIL.

The yields of oil obtained from fresh air-dried roots varied between 0·50 and 0·65 per cent. by weight, that is to say, 1 ton of roots will give 12 to 14 lb. of oil. The weight of roots obtained from the experimental areas was at the rate of about half a ton per acre, corresponding therefore to a yield of 6 to 7 lb. of oil per acre per crop. Under normal conditions two crops of roots can be obtained per annum, equivalent on the above figures to a yield of 12 to 14 lb. of oil per acre per annum.

VALUE OF OIL.

The sample of oil despatched to the Malay States Information Agency for valuation was forwarded to the Imperial Institute for report. The following is an extract from their report :

"The sample consisted of a viscid, dark greenish-brown vetiver oil of good aroma. It was examined with the following results, which are shown in comparison with corresponding figures recorded for (*a*) oil distilled in Europe from dry imported roots and (*b*) oil distilled in Reunion.

	Present sample.	European Distilled oil.	Oil Distilled in Reunion
Specific Gravity at 15/15° C. ...	1·032	1·014 to 1·042	0·982 to 1·020
Optical Rotation	Too dark to permit reading	+25° to +40°	+20° to +38°
Refractive Index 20° C. ...	1·524	1·520 to 1·523	1·515 to 1·528
Acid Value	35·5	25 to 65	4 to 20
Ester Value before acetylation ...	11·8	10 to 25	5 to 20
Ester Value after acetylation ...	162·0	130 to 160	120 to 150

These results show that the present sample of oil is of normal character.

COMMERCIAL VALUATION.

The chemically dried oil was regarded by experts of good aroma, resembling in this respect Reunion vetiver oil rather than Indian. They considered that it would be worth 30*s*. per lb. *ex* wharf London (January 1924) but were of opinion that the price of vetiver oil might fall in the near future."

USES OF OIL.

Vetiver oil is used exclusively in the preparation of compound perfumes, in which the oil, on account of its low volatility, acts as a valuable "fixer" for more volatile essential oils.

As in the case of other essential oils the utilisation of which is restricted to similar purposes, it is unlikely that the demand for this oil will ever be extensive.—Malayan Agricultural Journal, Vol. XII., Nos. 6 & 7.

CEYLON AGRICULTURE.

NUWARA ELIYA DISTRICT AGRICULTURAL COMMITTEE.

Minutes of a meeting of the District Agricultural Committee, held at the Nuwara Eliya Kachcheri on the 12th July, 1924.

Present.—The Assistant Government Agent in the Chair and the following members :—Messrs. G. F. Dewhurst, N. K. Jardine, U. B. Unamboowe, Ratemahatmaya, Kotmale, T. B. Wettawe, Ratemahatmaya, Walapane, and the Hony. Secretary. Mr. G. Madugalle, Agricultural Instructor, was present on invitation.

Letters and telegrams regretting absence were received from the following: Messrs. Bennett Leigh, G. G. Auchinleck, C. C. Wilson, and Mr. P. B. Andarawawe.

Minutes of meeting held on 26th January were read and confirmed.

Divisional Agricultural Officer's letter No. 586 of 29-2-24 was read and the following resolutions were adopted :—

(a) "To ask the Hon. the Director of Agriculture for a vote of at least Rs. 300·00 on account of paddy cultivation competitions in Uda-Hewaheta and Walapane to be awarded at the rate of Rs. 30·00 for each of the Ten Korales.

(b) Not to have a paddy cultivation competition in Kotmale in the financial year 1924-25.

(c) To apply to the Director of Agriculture for a vote of at least Rs. 100·00 for the Walapane Show and

(d) for a vote of Rs. 100·00 on account of tea garden competitions in Kotmale."

Resolved to have a Village Show for Walapane, at Harasbedda, on the 25th April, 1925, and further resolved to ask the Divisional Agricultural Officer, to draw up prospectus for the Show on the lines of the Alawatugoda Show.

Resolved with regard to tea garden competition in Kotmale, to ask the Divisional Agricultural Officer, to draw up conditions and to have leaflets distributed through the Agricultural Instructor.

Read Divisional Agricultural Officer's letters No. 1708 of 27-6-24 and No. 1820 of 3-7-24.

Proposed by the Hony. Secretary and seconded by the Ratemahatmaya, Walapane, that the 3 Agricultural Instructors be added to the Committee in place of the 2 Presidents of Village Tribunals who find it difficult to attend meetings.—Carried.

Mr. Madugalle read a paper on the progress made with regard to Cotton Cultivation in Walapane.

Mudaliyar E. F. Edirisinghe spoke in support of the motion in his name :—"That with the object of increasing the Colony's Food Supply and in order to obviate the delay in carrying out schemes and proposals for restoration and construction of Irrigation works that there should be more co-operation and co-ordination between the three departments most interested in agriculture, *i.e.*, the Irrigation, the Agricultural and the Revenue Departments."

Resolved that this meeting approves Mudaliyar Edirisinghe bringing forward the motion at the Board of Agriculture meeting and that Mudaliyar Edirisinghe expresses the views of this Committee as regards the desirability of closer co-operation and co-ordination to ensure the speedier carrying out of irrigation proposals.

POULTRY.

MATING FOWLS FOR UTILITY PURPOSES.

SELECTING THE LAYERS.

A. R. OLIVER.

Well-bred birds are essential, if uniform results are to be obtained. Type, for instance, is the quality that carries the characteristics of the respective breeds. Each breed has its own definite type and this must be fully grasped before intelligent mating can be accomplished. Breeders for utility purposes will do well to pay more attention to the matter. Mating birds, merely because they lay so many eggs will not preserve the characteristics of the birds that lay them ; under that system the breeders would be lost and the power to reproduce with them. Therefore, it is necessary to aim first at perpetuating the breed it is intended to keep, and then concentrate upon the improvement on the lines it is desired to perpetuate.

It is not sufficient to acquire birds of good strain, type, stamina, and prepotency, and imagine that nothing further is required. Careful selection is required in mating to preserve these qualities. Breeding from tested stock is looked upon by many poultry breeders as the only means of perpetuating desirable qualities, regardless of the fact that selection is important as well as blood, and breeding without selection is not likely to attain the desired end.

PREPOTENCY A FACTOR.

In mating for egg production, it is not sufficient to mate up the best layers to the best bred cock obtainable ; first aim at the breed, and then at improving its capacity. The best layer does not necessarily produce the most prolific progeny—prepotency has to be reckoned with as a factor in the transmission of any character and fecundity is more likely to be transmitted through the male bird than the female; it is more important that the male bird should be bred from a good layer. Putting it another way; Prepotency being presumed, better results, generally speaking, will be obtained by mating males, bred from prolific females, with hens of good flock average than by mating exceptionally prolific hens with male birds of a good average laying parentage; stamina is also more likely to be maintained.

STAMINA IS IMPORTANT.

Stamina in the birds to be mated is most important if the foundation is to be well laid. Stamina is not always visible. There are some unmistakable signs that portray it, such as bodily development, symmetry, brightness of eye and alertness—these are indicative of vigour.

An impression exists amongst many poultry keepers that it is necessary to mate two-year-old hens—from experience I have found it not so. This prejudice of breeding from a pullet in its first year of laying is not well founded. If a pullet, of say, nine to eleven months is not fit to breed from, she never will be. The objection is largely the result of immatured or under-sized hens that should never have been bred from at all, having been used in the breeding pens and having produced weakly stock. There is no reason for not breeding from male or female of the age mentioned,

provided they have been well grown. These considerations point to the necessity of using young, vigorous stock, rather than aged birds, the results from which are doubtful. Heavy egg production requires a high expenditure of energy, and to maintain this production the bird must have stamina ; the loss of vigour may not show in outward appearance but will do in lower production. Vigour is not so essential in breeding for show qualities but it is essential in breeding for egg production.

I do not wish to give the impression that all show birds are poor layers, but I will say it is possible for breeders to breed show birds, and at the same time maintain the vitality necessary for high egg-production: close in-breeding for either fancy points or utility points will not ensure layers.

SELECTING LAYERS.

When poultry keepers understand that a high layer is built entirely different from a low layer, he has acquired his first knowledge of selecting the good ones from the poor ones. No method of feeding, no assortment of food, will create a high layer out of a poor one—one may feed to increase weight and size, but one cannot feed a female chick to increase its capacity to manufacture eggs. One may select for capacity, and breed to perpetuate capacity in the offspring.

As important as feeding and environment are, both are relatively unimportant in comparison with breeding. Egg-production is an inherited character, and a good layer must be broad and deep in the posterior sections of the body. One must learn to differentiate between the relative depth and breadth of birds of various sizes—it is impossible to adopt an arbitrary standard of measurement. A four-pound Leghorn hen may be deeper and broader than her 3 or 3½ lb. sister and yet the latter may be much the better layer. One needs also to learn to correlate capacity with the weight and size of the various birds—capacity is determined by the distance between the pelvic bones and the breast bones. A hen with a contracted abdominal cavity cannot lay a large number of eggs. It is certainly true that the abdominal space does contract as soon as the birds stop laying, but a very high layer seldom contracts to the point where the boneless space narrows down to less than three fingers, and my advice is, do not breed from a hen that does not show at least two fingers' space when she is not laying and three fingers when she is laying.

MUCH MISUNDERSTANDING.

There is much misunderstanding relative to the pelvic bones, and many who have heard of the pelvic bone measurements think they are able to pick out the best layers. Certainly, the textures of the pelvic bones are fairly good indication of the ability of the bird to lay eggs, but the position of the pelvic bones simply tells whether the bird is laying or is not laying.

The fact that a pullet at this time of the year has her pelvic bones open to permit of the insertion of two or three fingers is not, in itself, an indication that the bird is a great layer ; the most it does indicate, is, the bird is laying. Now, should her pelvic bones be long and thin, sharp and flexible, the chances are she is a good layer, and if the texture of the pelvic bones as described above are in relation to the texture of the lateral process bones, one may be fairly certain that he has a splendid laying hen.

These are fine points, which should be looked for by the egg producer. I am sorry to see very little notice is taken of these points in the show pens (especially White Leghorns), so long as the width and breadth are there ; even if she is over weight, the pelvic can also be thick and grizzly, coarse in texture, also laterals, which certainly does not make the hen a good layer, nor do I think it is the correct meaning of the S.A.U. Leghorn standard.—South African Poultry Magazine and Small-holder, Vol. XVII., No. 149.

THE VALUE OF CHAROCAL.

Very few small poultry keepers realise the value of charcoal in cleansing the fowls' system and keeping away disease. Many birds which appear out of condition owing to digestive troubles or other complaints can be brightened up and restored to health by having free access to a hopper of prepared charcoal, but, as with grit, it should not be mixed with the food, forcing the birds to eat more than they require.

Prepared charcoal is sold by most dealers in poultry foods. If the birds are provided with a dust bath of ashes it will be noticed that they will readily pick out small particles of charcoal or wood ash while dusting themselves. Green sticks make the best charcoal, and in preparing it at home, the best method is to enclose a few at a time in an old tin box and embed it in the middle of the kitchen fire overnight. By the time the fire is raked out in the morning the charcoal will be found ready for use. The charcoal should be supplied in a hopper in the same way as grit and shell.—South African Poultry Magazine and Small-holder, Vol. XVIII., No. 150.

THE METHOD OF FEEDING CHICKENS.

After the chickens are fasted for 36 to 48 hours, the first feed should be coarse sand ; then feed for the first two days on coarse oatmeal or rolled oats. We often hear of breeders feeding their chickens for the first two days on hard-boiled eggs ; if this was discontinued the results would be far better. It should be remembered that the yolk of the egg is the last thing to be absorbed into the chicken's body before leaving the shell, and that combined with the feeding of a hard-boiled egg is enough to upset the chicken and bowel trouble results.

For the second day give a grain mixture, either prepared or you can prepare it yourself.

A good formula for the first four weeks is : Cracked wheat, 3 lb.; cracked Kaffir corn, 2 lb. ; millet or inyati, 2 lb. ; cracked mealies, 1 lb. ; Canary seed, 2 lb.

After four weeks :—Wheat, 4 lb. ; cracked mealies, 3 lb. ; Kaffir corn, 2 lb. ; cracked peas, 2 lb. ; or Buckwheat, 2 lb. One pound of grit may be added to the mixture.

If possible, give the chicks plenty of milk to drink and have dry mash in hoppers always before them. A good dry mash for chickens for the first two months can be made up as follows : Pollard, 4 lb. ; bran, 6 lb.; mealie meal, 1½ lb. ; pea or bean meal, 2 lb. ; ground oats, 3 lb.; lucerne meal, 2 lb. ; one pound of bone meal. After the second month the same mixture can be continued deleting the bone meal and substituting 1½ lb. meat meal, We have given the smaller quantities in pounds to suit the smaller poultry keepers, for larger quantities it can easily be worked out in proportion.—South African Poultry Magazine and Small-Holder Vol. XVIII., No. 151.

CO-OPERATION IN CEYLON.

PROGRESS OF AN URBAN SOCIETY THE GOVERNMENT PRINTING OFFICE CO-OPERATIVE SOCIETY, LTD.

N. WICKRAMARATNE,

Secretary, Board of Control, Co-operative Societies.

It is well known that the Co-operative movement has made progress in rural areas. This has often led the residents of towns to think that the movement is one meant for the benefit of the villager to enable him to carry on his work in connection with agriculture. The attention paid by the residents of urban areas to the manifold uses of the Co-operative movement and to the benefits that it would impart to the town residents is very small. But no one can gainsay the fact that where Societies have been formed and well worked in urban areas they have met with great success, and, there is ample evidence of the benefits of the movement gained by the population of large towns and cities.

The Government Printing Office Co-operative Society, Ltd., was started and registered in September, 1917, for the benefit of the employees of the Government Printing Office, which is located in Colombo town. This is a Government Department and some two to three hundred persons are employed in it, most of whom reside in the town. Many of these employees are daily paid hands and their income is very small. A large number of them, as was subsequently found out, were in debt to usurious money lenders, who charged very high rate of interest. The objects of the Society as laid down in the bylaws are as follows :—

1 "The encouragement of thrift by affording a ready means of putting away a portion of one's income on which a return in the way of annual bonuses may be reckoned on.

2 The preventing of hopeless indebtedness by enabling members to obtain loans from the Society at a reasonable rate of interest."

The capital of the Society was fixed at Rs. 2,500/- divided into 500 shares of Rs. 5/- each, the value of shares allotted to members being payable in full or by monthly instalments of Re. 1/- for each share taken by a member.

As one of the objects of the Society as defined in the above bylaw was the lending of money at a low rate of interest it is of some importance to know that 18 per cent. per annum was voted by members as the lowest rate of interest that the members would approve. The Registrar with considerable difficulty reduced the rate to 12 per cent. per annum later. This will give an idea of what may have been the rate of interest the members were paying previously.

At the end of march, 1918, which was then the end of the co-operative financial year the first Annual General Meeting was held. The position

of the Society at that time was as follows :—

Members, 200; Paid up capital, Rs. 2,027 ; Reserve fund, Rs. 183·57 ; 88 loans amounting to Rs. 3,190/-had been given. The bylaws require the purpose to be stated by the borrowers for which loans are taken and as a result of this bylaw it was found out during the first year's working that a number of borrowers borrowed either for the purpose of settling debts or for paying interest on loans contracted previously from outsiders. Enquiries were made regarding the extent of the members' indebtedness and it was found that the members were in debt to the amount of over Rs. 3,000/- to outsiders, and that the rate of interest sometimes rose to 120 per cent. per annum. With the very generous support of the President of the Society, who deposited with the Society a sum of Rs. 2,000/- without interest, the Society was able to redeem all the previous debts of its members. Hence in the second year's working of the Society, the members' indebtedness to outsiders happily ceased. At the second Annual General Meeting held in 1919, the position of the Society was as follows :—

Membership, 218; Paid up capital, Rs. 3,672/-; Loan, Rs. 2,000/ (deposit of the President taken as a loan). Rs. 10,875/- were lent during the second year. In the third year the Rs. 2,000/- given by the President was returned with the thanks of the Society, and the Society was by then quite a popular institution among the employees. The third years' balance sheet shows 218 members; Rs. 4,330·00 paid up capital; and Rs. 325·85 to the credit of reserve fund.

This year the Society has had no liability except the liability of the paid up share capital of the Society. It may be stated that at the end of the previous year the rate of interest was reduced to 12 per cent. by common consent. In the fourth year the membership rose to 220 and the paid up capital to Rs. 4,935/-, the Reserve Fund of the Society amounting to Rs. 464·09. By this time the Society had declared three annual dividends of 12, 8, and 8 per cent. respectively, aggregating 28 per cent. per share.

During the year the Society reached another stage of progress. The members agreed to launch a provident fund scheme which received the approval of the Registrar. Necessary bylaws were passed and the scheme became an accomplished fact on the 1st July, 1921. The object of the scheme is to ensure to its members the benefits of a donation, to be given to them or their nominees on their final retirement from the Government service and the Society, or on death to their nominees or heirs-at-law. The fund is to be raised in any or all of the following ways, *viz* :—By entrance fees, by deposits, by donations, and by any money received as interest on investment of the fund. This fund is not liable for the debts of the Society. Only members of the Society are eligible for membership of the fund, and on retirement from employment at the Printing Office a member ceases to be a member of the Society and of the fund. Each member is required to pay a monthly contribution of Re. 1·50, which amount is deposited to his credit. On the retirement, or death, of a member he or his nominee will be paid all his deposits together with a donation of Re. 1·50 from each member. This donation is collected as occasion arises by special calls from members. Monthly contributions are not confiscated for non-payment of such contributions. If a member fails to pay his monthly contributions for three consecutive months he will cease to be a member of the fund, and any money lying to his credit will be paid to him. Provision has also been made for the payment of a certain amount to the nominee of a member to meet funeral expenses in the case of death. This fund has received the whole-hearted support of the majority of members and is being worked with satisfactory results. At the end of the first year it had 194

members and a sum of Rs. 2,267·30 to its credit. At the end of second year there were 214 members and an amount of Rs. 4,782·16 to its credit. Donations were paid to the two nominees of two deceased members. The finances of the Society as well as those of the Provident Fund have increased from year to year, and at the end of the last financial year ending in April 30, 1924, the funds stood as follows :—

BALANCE SHEET OF THE SOCIETY.

Assets.	Rs.	cts.	*Liabilities.*	Rs.	cts.
Balance in hand ...	32	00	Paid up capital ...	14,250	00
Balance in Bank ...	896	02	Declared bonus (dividends) lying to the credit of members...	2,225	15
Loans due by members	17,079	00	Bonus due to members (to be declared)...	1,148	91
Reserve Fund in Bank	1,060	68	Reserve Fund ...	1,443	64
Total Rs.	19,067	70	Total Rs.	19,067	70

The number of members on 30th April, 1924, was 292.

BALANCE SHEET OF THE PROVIDENT FUND.

Assets.	Rs.	cts.	*Liabilities.*	Rs.	cts.
Balance in Bank ...	4,800	39	Contributions by members ...	7,008	00
Investments (on loans)	1,715	00			
Due from members ...	862	00	Profits (interest, etc.) ...	369	39
Total Rs.	7,377	39	Total Rs.	7,377	39

During the last year donations amounting to Rs. 3,387/- have been paid to 9 members.

These particulars will show the financial progress of an urban society where the members had nothing to their credit at the beginning ; in fact, a number of members were then in the hands of the money lender. By the application of co-operative methods by members they were able to save a sum of over Rs. 26,000/- within seven years. To this the amount paid to outside creditors, *viz.* Rs. 3,000/- has to be added. The number of members of the Society being 292 this works out to an average of Rs. 90/- per member. The average yearly savings of the members is Rs. 3,777/-.

This is only one instance where co-operative movement has helped a group of an urban population. What is possible at the Government Printing Office is possible in any department of Government or any mercantile office where large numbers of persons are employed.

GENERAL.

PAPAIN.

B. J. EATON, O. B. E., F. I. C., F. C. S.,

Agricultural Chemist, Dept. of Agriculture, S. S. & F. M. S.

Articles on "Papain, its production and uses" and "The Preparation of Commercial Papain" were published by the writer in the *Agricultural Bulletin*, Vol. II., No. 7, February 1914, pp. 190-192 and Vol. V, Nos. 5 and 6, February-March, 1917, pp. 202-203.

The information contained in the present article embodies that previously published, together with additional information from other sources and replies received from various firms in England, Canada and America which are interested in this product.

Source of Raw Products.—Papain is a proteolytic or digestive enzyme contained in the juice of the fruit and other parts of the Papaya tree (*Carica papaya*).

The commercial product, which consists of a cream coloured or white powder is obtained from the fruit of the tree.

Cultivation.—The papaya tree, as is well known, grows extensively in Malaya and other eastern tropical countries and other parts of the tropics, including tropical Australia and is grown largely for its fruit.

There are three kinds of trees (*a*) hermaphrodite or perfect flower, (*b*) female or pistillate, (*c*) male or staminate. The trees are propagated from seed, which should be sown in a well prepared seed-bed about ½ inch apart. The seeds should be covered lightly with soil and the seed-beds should be well watered. The beds should be shaded and, if the seeds are sown during rain, the beds should be sufficiently protected to prevent the washing away of the seeds.

The seeds germinate in about 2-4 weeks and may be transplanted when about 3 inches high. The plants should be watered before transplanting and three-fourths of the leaf blades should be removed to prevent wilting. The soil should be well pressed round the roots and the seedlings planted at about 10 feet apart. Cover crops may be grown on the land. Water should be supplied, if the plants tend to wilt. The plants however will not tolerate a water-logged soil. The trees begin to bear fruit after about one year and the fruit may be tapped to obtain the juice when they are three months old. Only mature, but not ripe, fruit should be tapped.

Cattle manure is applied largely in India in the cultivation of the tree. The following mixed fertiliser has also been found to be very successful in Hawaii—Superphosphate 800 lbs., sulphate of potash 315 lbs., nitrate of soda 250 lbs., sulphate of ammonia 190 lbs., volcanic ash 445 lbs. Ploughing and harrowing during the early stages of growth, are also recommended in India.

If properly looked after, the plants may last for 5 to 10 years but the period of profitable production is said to be 3-4 years. Special fruits, varying in size and shape, can be produced by adopting suitable breeding methods.

Composition of Fruit.—Analysis of the fruit has given the following results:—

	Per cent.
Water	90·75
Protein	0·80
Oil or Fat	0·10
Nitrogen Free Extract	6·32
Fibre	1·09
Ash	0·94

The most important constituent is the digestive or proteolytic enzyme—papain.

Preparation of Crude Papain.—The juice, which contains the papain, is obtained by making shallow longitudinal incisions, about ⅛ inch deep, in the unripe but well-grown fruits, by means of a non-metallic knife (a bone or ebonite knife). Rustless steel knives will be satisfactory if it is found that they do not discolour the juice.

Fruits in which only three to four incisions are made simultaneously, can be incised again after a day or two, but, if seven to eight incisions are made, subsequent tapping is said to yield very little juice or latex. The juice resembles a white thin sticky latex, which coagulates rapidly.

The fruits should be incised in the early morning and the juice strained through muslin and dried at about 35°C for two days, when it forms a cream coloured brittle mass with an unpleasant odour. The mass can be ground to a powder.

The juice should be collected in glazed earthenware or china cups. A trace of formalin added to the juice prevents decomposition. Small quantities of juice may be dried in the sun on sheets of glass. Large quantities however are prepared preferably by spreading the juice on linen trays made by stretching brown linen on wooden frames placed over a hot-air chamber of brick, avoiding excessive heat. This can be done by using an iron plate covered with 2-3 inches of sand between the fire and the hot air chamber, with the trays about one foot above the plate. Artificial drying in this way should be done below 100°C (below 40°C); on a large scale vacuum drying would be found to be very efficient. The juice contracts on drying and the contents of several trays can be placed subsequently in one to complete the drying. The juice should be dried till it is crisp and capable of being reduced to a powder. A cream coloured or white powder is obtained.

The yield of crude dried material amounts to about 16-18 per cent. of the weight of the juice.

The yield per tree will depend on locality and amount of fruit. A tree with thirty fruits may yield 1 lb. of crude papain. A dozen shallow cuts about ½-¾ inch apart on a fruit of good size will yield ½ oz. of papain.

One authority gives 0·4 lb. of fresh latex per tree while 40 fruits have yielded the same amount. In Ceylon the yield is from ½ to ¾ lb. of papain

per tree. In India the trees are planted 400 to 500 per acre and the cost of cultivation, collection and preparation of papain is estimated at 200 to 250 rupees per acre.

Purification and Standardisation of Papain.—The commercial product is said to be often adulterated with starches. The "activity" number (*i. e.* the amount of protein digested in a fixed time at a definite temperature by unit weight of papain) varies considerably.

By Pratt's method (digestibility of casein from milk) commercial samples from Ceylon gave "activity members" from 0·5 to 9·7. Mexican samples have given 12·9 and West Indian samples 40·0. Philippine samples, prepared in the laboratory, of fresh latex (on dry basis) gave 45·8, undried latex (on dry basis) 45·4, alcohol precipitated papain 72·2 and Indian samples 44·4 on egg albumin.

(*Note:*—Pratt uses a 40 per cent. solution of a sweetened condensed, skimmed Milk as substrate and a 0·5 per cent. aqueous solution of papain.)

25 ccs of milk, with 23 ccs of water and 2 ccs of a filtered papain solution containing 5. m. grams of papain per c.c mixed and at the end of the digestion period (30 minutes at 40°c) the undigested casein is precipitated by adding 0·5 ccs ot copper sulphate solution (6 per cent.) followed by 0·5 ccs of glacial acetic, with vigorous stirring during the precipitation. The precipitated casein is broken up, washed on a filter, dried in an oven and weighed. A blank experiment is used as a control. This method has been adopted by subsequent experimenters in the Philippines, on account of its reliability and simplicity.

Brill and Brown of the Philippine Bureau of Science (*The Philippine Journal of Science*, Vol. XX., No. 2, Feb. 1922, p. 185) state that papain appears to lose its activity on keeping ; a sample examined by Pratt in 1914 which digested 85 per cent. of the casein in milk in 30 minutes, had lost all its activity in 1921, although the dried material had been sealed up in small glass vials and protected from sunlight.

These experimenters found that alcohol-precipitated papain is more active than sun-dried papain. By dialysis of the milk (a 10 per cent. solution of a dried milk powder was used, instead of the sweetened condensed skimmed milk employed by Pratt) to remove mineral salts, greater activity was shown.

These experimenters conclude that autolysis of papain takes place at temperatures as low as 0°C when the enzyme is put in water with toluene as an antiseptic. Sodium chloride shows first a slightly activating effect followed by an inhibiting effect in more concentrated solutions ; sodium carbonate and bicarbonate and calcium chloride, magnesium sulphate and boric acid have no marked effect ; potassium chloride and sodium citrate showed marked activation while acetic and lactic acids showed strong inhibiting effects.

The following method of purification has been applied in India :—20 grammes of fresh latex are stirred with 100 ccs of 95 per cent. alcohol producing a white gummy coagulum. The alcohol is poured off and a further 50 ccs of alcohol added to the coagulum, which crumbles to a fine powder. The powder is filtered and washed with ether to remove a

semi-solid yellow wax and to facilitate drying. The washed papain is dried in vacuo and gives a pure white powder, amounting to 3 grammes, equivalent to 15 per cent. on the fresh latex. The papain is tested by using 15 ccs of egg albumin made up to 25 ccs with a 1 per cent. solution of sodium chloride to which 1 cc of papain solution (0·01 papain) is added. The mixture is digested for 15 minutes at 80°C. The following results were obtained on different samples of papain :—

(*a*) Juice dried at 35°C, (Neutral). Protein digested 55·9 per cent.

(*b*) Dried juice extracted 10 times with water for 6 hours and filtered; extract precipitated with 2 volumes of 91 per cent. alcohol and dried in desiccator. (Neutral.) Protein digested 51·0 per cent.

(*c*) Fresh latex precipitated with 2½ volumes of 91 per cent. alcohol and dried in desiccator. (Neutral). Protein digested 56·8 per cent.

(*d*) Latex treated as in (c) and then washed with ether after drying for one day and then dried in desiccator. (Neutral). Protein digested 67·1 per cent.

(*e*) Fresh latex precipitated with 5 volumes of 94 per cent. alcohol and washed three times with ether, and dried in desiccator. (Neutral). Protein digested 57·7 per cent.

(*f*) As per (e) but solution acid. Protein digested 2·8 per cent.

(*g*) As per (e) but solution acid. Protein digested 2·8 per cent.

These results indicate that the papain prepared from the juice by precipitation with alcohol and subsequent washing with ether gives the most active product.

It will probably however be preferable to leave the purification to the manufacturers who purchase the raw product and to prepare a good dried juice on the estate.

The following points in the preparation should be noted :—

(1) The juice should be dried as soon as possible.

(2) The drying should be effected below 40°C, otherwise the activity of the papain will be reduced or destroyed.

(3) Final drying is effected preferably in a vacuum drier.

(4) The product should be ground to powder and packed at once in air-tight stoppered bottles or lead-lined wooden boxes.

Further experiments indicated a remarkable activity when the digestion of the protein (Egg albumin) was carried out at temperatures as high as 90 to 95°C. in acid or neutral solutions, which seems remarkable.

(*Note*:—Details of the above experiments are contained in (*The Philippine Journal of Science* Vol. XX., No. 2, February, 1922, p. 185 and *The Agricultural Journal of India*, Vol. XVI., No. 5, Sept., 1921.)

Markets and Value:—The following information has been received in reply to a questionnaire addressed to various firms in England, Canada and America.

Firm A. (New York, U.S.A.) Imports into United States of America for year ending June 30th, 1914, Papain extract—39,419 lbs. valued at $74,866 gold. From Germany 94 per cent. From England 6 per cent. Papain "select"—6,181 lbs. valued at $26,613 gold.

Germany—89 per cent, Holland—8 per cent, British West Indies—3 per cent.

The product described as "Select" is probably a dry crude papain. The crude papain, which is now imported, is packed in bags and fetches $1·50 to $1·75 per lb. C.I.F. New York (December 1922). It is usually sold on test. The amount imported at present is probably about 50,000 lbs. per annum.

Firm B. (England).—No information of any value.

Firm C. (Canada).—The dried juice should be packed in a tin, glass or jar container and sealed. The product should be bone-dry.

This firm imports juice from its own estate, packed in ordinary kerosene or gasoline tins

Firm D. (England).—This firm quotes prices from four different wholesale lists as follows:—(A) 3/2 per oz. (B) 2/6 per oz. (C) 3/2 per oz. Merch's 22/2 per lb.

Firm E. (England).—No information of any value, except as to packing in air-tight containers. This firm states there is a very restricted market in London, as papain seems to have largely gone out of use in medicinal preparations.

Firm F. (England).—Market price (Sept. 1922) 7/3 per lb. The product should be packed in lead lined cases containing about 56 lbs. There is a fairly good demand for the product, which is sold on test. It should be free from sugar and starch.

Probably between 250 and 500 lbs. per month could be taken.

Firm G. (England)—branch of New York Firm A.—Market in London very limited and consignments sent to England appear to have been chiefly exported again. The United States of America is the chief consuming country.

The above replies appear to indicate that the chief consuming country is America.

The present price of this product is 3/2 per oz. in London and $2/15 to $2/25 gold per lb. in 10 lbs. bottle (*U.S. Pharmacopœia*) Powder or $1/85 to $1/90 per lb. Crude, in 150 lb. cases.

Conclusions.—The cultivation of the Papaya tree or the production of papain should be an economic proposition on a small scale. The plants could be grown with other crops; coffee, or kapok could be grown if the papaya trees are planted widely.—Malayan Agricultural Journal, Vol. XII., No. 5.

NURSERY METHODS THAT AFFECT PROFITS.

O. BROOKS,

Senior Fruit Inspector.

Every orchardist is familiar with the unprofitable, unthrifty tree, but not every orchardist connects the condition of such trees with careless treatment in some apparently trivial detail in the nursery. Yet it is not too much to say that it is often the man who handled the tree at some early stage in its life that is to blame and not the tree itself. In fact, better nursery methods would greatly reduce the number of unprofitable trees, and relieve the industry of a substantial burden.

When the amount of time that is entailed in connection with each tree in the orchard is considered, the additional time often given to poor trees in the hope of improving them, and the rental each should carry for the land occupied—when all these things are totalled, it will be found that the unprofitable tree is a very significant item indeed, and that if every such tree in the orchard were replaced by a vigorous cropper the grower's position would be appreciably better.

On the principle that prevention is better than cure, it may be profitable to go back to a few nursery errors and to indicate why and how they should be avoided. The straight path in nursery work may be said to have been indicated long since by Mr. W. J. Allen, but it may prove useful to point out a few of the pitfalls that strew the track, and to show the losses and misfortunes they occasion. We deal primarily with citrus stock, but some of the suggestions may be found applicable to other classes of trees.

THE SEED-BED AND THE SEEDLINGS.

A well-drained piece of land should be selected for the seed-bed, and the soil worked into a friable, fertile condition during the winter, a little sand and manure being used if necessary to open up the soil and increase fertility.

The usual practice in this State is to use seed from the common lemon for raising seedling stocks. It seems to do well on all classes of soil and is a greater forager than many other stocks. It has generally been thought that the common seedling orange stock is best under irrigation conditions, but it is more difficult to get the buds to "take," and is about one year in five slower in coming to maturity. Another stock now being extensively used in America is the "sour orange stock," and it might be tried with advantage on our sour coastal lands and also on our irrigation areas. One or two nurserymen in New South Wales have recently obtained seed and successfully raised stocks and budded them. It grows into a very big tree, and seems to do well on low-lying, wet ground, and therefore might be found useful on wet coastal lands and on irrigation areas. "Sour orange stock" must not be confused with the Seville or bitter orange, grown here commercially. The latter has given good results in some countries, but here it has proved a complete failure as a stock.

Seed should be only taken from ripe fruit, and seems to germinate much better if allowed to dry with its own juice unremoved.

The seed is broadcasted by hand over the bed in the spring, and then covered with soil to a depth of about 1 inch.

In five or six weeks the young seedlings are up, and it becomes necessary to provide shelter from the sun. This is usually done by erecting a frame 5 to 6 feet high, and lightly covering in the top with ti-tree shrub or similar material, but without closing in the sides.

DISCOURAGE TAP-ROOTING.

Under these conditions the seedlings grow for twelve months or so, and in the spring following the sowing they are ready to be transferred to the nursery bed. The site for this, like that for the original seed-bed, should be well-drained, and the soil should be prepared by a light surface-working only. This is no doubt contrary to what might be expected, but

he point is of importance. If the soil is deeply worked the roots of the seedling trees strike downwards and form tap-roots, and tap-rooted plants, though growing rapidly in the nursery bed, do not do well after they have been worked in the nursery and planted out in the orchard. What is wanted—and what the experienced orchardist looks out for—is nursery stock with root systems that branch just below the surface and form vigorous fibrous roots that are capable of taking up plenty of moisture and plant-food. Tap-rooted trees are scantily supplied with the fibrous roots that are necessary to vigorous growth.

The method, then, of preventing tap-rooting is to work the surface soil only and thus by having firm soil beneath, to force the roots to spread out while they are still young and tender. It is consistent with this method of preparing the nursery bed that the cultivation of the soil while the young plants are growing shall also be quite shallow—but of that more later on.

TRANSPLANTING TO THE NURSERY.

From the seed-beds the seedlings are planted in the nursery in rows 3 feet apart, and 8 to 9 inches apart in the rows. It is essential to the best results that the roots shall be well spread out. Knots or twists in the tender roots check the flow of sap and prevent the free vigorous growth of the tree. It is not too much to say that 25 per cent. of seedlings are planted out anyway in the nursery, the roots being allowed to be kinked and crooked, with the result that they become misshapen and knotted. Many an orchardist has wondered what is the matter with a tree that does not thrive like the rest of the same planting, and it is certain that in large proportion of cases the cause is careless transplanting in this respect. No doubt many trees planted quite carelessly grow all right, but the proportion of failures in the nursery and of disappointments in the orchard is larger than it need be.

A good method is to open a shallow furrow or a double furrow (one thrown outward each way in the nursery bed), and then to plant the young stock along the furrow, carefully combing out the roots, if need be over a cone. No doubt there is work in it, but a tree is planted to last for many years, and can only be profitable if it is encouraged to form a good rooting system from the beginning.

The method adopted by many nurserymen is to throw out a trench with a spade, leaving a straight hard bank on one side. Against this bank the young seedlings are thrown and the soil is turned or raked in so as to cover the roots. The disadvantages of the system are obvious. In addition to the possibility of the roots becoming twisted and kinked in the process of covering, there is the firm soil on one side and the loose soil on the other, with the consequent tendency of the young trees to grow more freely on the side of the loose soil than of the firm soil, and therefore to become unshapely and less vigorous than they might be.

Many nurserymen give a light dressing of bonedust—say, about 2 cwt. per acre—just after the seedlings have been planted out in the nursery, and follow it up with other similar applications at intervals until the young trees are ready for planting out in the orchard. The object of this manurial treatment is not only to stimulate growth, but to keep the roots near the surface and to encourage the formation of a strong fibrous rooting system by supplying the surface soil with plenty of plant-food.

WHAT TO AVOID IN BUDDING.

In the autumn or spring following the setting out in the nursery many of the young stock should be ready to bud.

Only well-matured wood should be used. For autumn budding the previous spring growth is generally used, and for spring budding well-matured wood of the previous summer's growth. A good deal depends upon the weather, of course, for in a dry summer the growth will not be strong, and the wood is therefore unsuitable for budding purposes.

Autumn budding is generally favoured because it is possible if some buds fail, to rework the stocks in the spring, and in a good season the later working will almost catch up to the previous autumn's.

It is the practice of some nurserymen to continue to bud into stocks even after two or three buds have failed, but it is most unprofitable to the orchardist and should be discouraged. No doubt there is a strong temptation to make use of young stocks that still appear quite healthy. A poor "take" may be obtained from an autumn budding, and in the spring a cold night or a spell of wet weather may follow the working, and again there is a disappointing result. What more natural than that a further attempt should be made to turn the stocks to account in the following autumn or spring? The trees obtained under such conditions, however, rarely mature into good commercial assets. To ensure maximum success in nursery work—and nothing less will do in these keen days—everything must be succulent and free growing, and anything not answering to that description should be absolutely discarded.

One method, which is only applicable to coastal districts, and which in favourable seasons is successfully adopted by a few nurserymen, is to plant seed about November, transplanting the seedlings the following spring and budding in December. If the weather conditions are suitable the buds "take" and start to shoot quickly, making very rapid growth. Light applications of bonedust and sulphate of ammonia are given to the trees, creating a strong fibrous root system, and sometimes resulting in the young trees being so far forward that they can be transplanted early in the autumn. If not ready quite so soon, they are available, of course, for transplanting in the spring. The method tends to produce a well-rooted little tree, which makes up very rapidly when transferred to the orchard.

WHAT SELECTING BUDDING WOOD MEANS.

Orchardists have begun to realise in recent years the value of selecting the budding wood from trees known to be good bearers—and not irregularly so; they shoud be known to be regular bearers over a number of years. Many of our best varieties of citrus fruit are beginning to show signs of deterioration and "running-out," apparently the result of continual inter-working on to lemon stocks. What is required is that for budding wood we should go back to trees true to type of the original varieties. Valencia Late and Washington Navel—both valuable varieties—exhibit tendencies to run out, and only resort to trees of good, vigorous bearing habit and true to type will save them for growers. The necessity appears to be the greater because of the continual use of the lemon stock Were the seedling orange stock

more extensively used there would perhaps be less trouble in this respect. Meantime it would be well worth orchardists' while to pay pounds per hundred more for trees known to be properly worked in this respect than for inferior sorts.

It is a good practice to insert the bud, say, 2 or 3 inches above the ground level. The union of scion and stock is the part of the tree most liable to diseases like collar rot, and if the bud is a bit high it is easier to ensure a good clearance when planting out. If the union is covered when planting out takes place, and is kept covered in the subsequent cultivations, the trees seems to smother and never makes the vigorous growth that produces a good bearer.

In coastal districts in particular, shallow planting is an advantage because cultivation tends to work the soil up to the tree and therefore to cover the union.

Whether a little bit of wood should be left in the bud in taking the bud from the stock is much discussed, but on the whole there seems to be some advantage in leaving a thin shaving. Among other things it seems to prevent the tendency for the bud to split on the inside when brought under pressure in inserting and tying in place on the stock.

SUBSEQUENT TREATMENT IN NURSERY BED AND ORCHARD.

Heading is always done in the spring as soon as it is apparent that the bud has taken and is starting to shoot. Some nurserymen when cutting the stock back after the bud has shot leave quite a stub above the bud, but in time this dies off and not only prevents the bark from spreading over and covering the whole surface, but tends to produce an unshapely tree. It is much better to make the cut fairly close to the bud, and not straight across, but at a slight angle, so that there is as little wood as possible to die off. A good sharp tool should be used, so that the bark shall not be bruised or injured in any way.

As soon as heading has been done, each stock should be staked with stakes half an inch square and, say, 3 feet long. As the shoot grows it must be tied to the stake to prevent it from being torn or blown out.

Throughout the growing period of the young tree disbudding must be carried on regularly. It is again essential that the implement be sharp, so that the wound may be a clean, smooth one that will heal well. If the buds are rubbed off, as many nurserymen do, a rough callous surface is formed and the vigour of the tree suffers the more. Orchards have been seen to grow into a very scraggy-looking lot of trees, and examination suggested strongly that this rubbing off was one of the material causes for unthriftiness.

When two shoots develop from one bud, as sometimes happens, only one should be left. The practice of some nurserymen of allowing the second shoot to grow in order that it may provide budding wood is a very bad one, and is probably one phase in the deterioration of certain useful varieties.

Finally, in connection with the transfer from the nursery bed to the orchard, as much as possible of the fibrous roots of the little tree should be lifted. Many failures are due to careless lifting, and many more to careless

planting. The suggestions made above about the combing out of the roots so as to avoid knots and kinks are again applicable, and their adoption will contribute materially to the profit-earning capacity of the orchard. Where the roots run in layers, each layer should be carefully separated and covered with soil, one at a time.

To some growers a good deal of the foregoing no doubt appears to be unnecessary, but the successful establishment of an orchard—like the establishment of any other business that is to produce maximum returns—depends upon a proper appreciation of many details, each of which contributes in its measure to the efficiency of the whole, and each of which is therefore worth the careful attention of the proprietor.—The Agricultural Gazette of New South Wales, Vol. XXXV., Part 7.

NUTMEG AS A VILLAGE CROP IN CEYLON.

W. MOLEGODE,

Agricultural Instructor.

The Nutmeg tree (*Myristica fragrans*) is often seen in village gardens, and is one of the principal trees in most gardens attached to Buddhist Temples in Kandy district, but nowhere is it grown on any large or commercial scale. For some years the writer has devoted some time to the study of nutmegs as a village crop, confining his observations to Kandy district, and the results lead him to believe that nutmeg growing, purely as a village crop, is worth encouraging. Just ten years ago a scheme was suggested with the view of encouraging and extending nutmeg cultivation among villagers who owned gardens. The suggestion was to supply plants and at a later stage award a number of prizes among the most successful growers. The scheme did not go through, but a number of plants were distributed amongst a few people, and to-day some of these plants are bearing fruits. There is plenty of scope for pushing forward the establishment of small groves of nutmegs in villages. The existing trees have given good results and the owners get fair returns of money every year. For instance, a tree at Gohagoda, in a garden called Nugegode Watte, has been leased out during the last ten years for sums varying from Rs. 10/- to Rs. 15/- per year. During the last three years—the writer can testify to this—26,800 nutmegs and 48 lbs. of mace were got from this tree. The tree measures 4 ft. 4 ins. in girth and spreads 17 feet each way. In an adjoining garden there are 5 trees from which the owner gets regularly Rs. 18/- to Rs. 20/- per year. A hundred yards from here are 11 trees realising Rs. 40/- to Rs. 50/- a year. In Deegala there are two trees and for the past five years the crop has averaged 8,000 nuts for the two trees. The writer has kept records of 80 trees within easy reach of his station, and of these 80 trees more than half have given 3,000 nuts per tree per year.

These notes are written in the hope that the question of nutmeg cultivation in the villages will interest some, at least, and that it will lead to the establishment of even a couple of trees in most village gardens. The writer has made a commencement in Harispattu and already sixty villagers have planted between them 360 seeds during this monsoon.

The nutmeg trees are usually unisexual, bearing male or female flowers only, but frequently trees with flowers of both sexes on them are to be found. It has also been recorded that there have been cases where trees bearing male flowers after some years have produced female flowers and ultimately became entirely female trees. It is difficult to say, until the tree has flowered, whether it is a male or female or a hermaphrodite. The bell-shaped yellowish flowers are produced on foot stalks a little above a leaf. The female flowers are larger than the male flowers and are more fleshy and more oval-shaped. The female flowers develop into fruits, consisting of a fleshy covering or pericarp containing the nutmeg (seed) enclosed in a deep brown hard shell or seed coat over which lies the mace. Hardly any use is made of the fleshy husks. The seeds are the nutmegs of commerce. The chief uses of nutmeg and mace are as spice and for the preparation of perfumes and scented soap. The nutmeg yields an essential and a fixed oil. The fixed oil is known as "nutmeg-butter." The mace yields an essential oil. Locally both nutmeg and mace are employed as flavourings and condiments and to a fair extent in native medicines.

SOIL AND CLIMATE.

Nutmeg can be grown on a variety of soils. Some of the finest nutmegs are stated to be grown on the steep exposed slopes of granite hills in the Malay Peninsula, the soil of which is a yellow loamy clay. In Ceylon most suitable seems to be a rich, deep, friable soil with good drainage. Sandy soils, which soon dry, and soils on which water stagnates, are unsuitable for nutmegs. Even the slightest retention of water around the roots of a nutmeg tree has proved to be harmful. Some of the best-yielding trees in the Kandy district which the writer has seen are growing on undulating land with natural drainage.

There is a common saying that the nutmeg must be able to smell the sea. Here in Ceylon at any rate the nutmeg is growing very satisfactorily at Peradeniya, and in Kandy, Matale, and Badulla. Some of the oldest trees, giving extraordinarily large crops every year, are to be found near Halloluwa, Katugastota and in Tenne in Matale. Nutmegs can be successfully grown up to an elevation of 2,000 feet above sea level. The rainfall should be at least 60 to 70 inches.

The trees, both when young and old, must be protected from strong winds.

PLANTS.

The tree can readily be raised from seed. Freshly gathered seed only should be used for raising plants. Seeds do not keep long in good condition for planting. Dry nuts, those that rattle when shaken, seldom germinate. It is advisable to plant the seed within a day or two of gathering.

Plants are preferably raised in joints of bamboos or supply baskets because that gives the advantage of easy and safe transplanting. If raised in nursery beds, seeds should be put about a foot apart and should be buried about an inch deep. Soil in which seeds are planted should not be allowed to get too dry nor should too much water be applied. Nurseries should be carefully shaded. Generally, if the seeds are sound, they should germinate in about a month to six weeks. Sometimes they take two months. It must be remembered that moderate watering and careful shading are essentials

to successful raising of plants. If the soil is allowed to become dry, germination will not take place. The growth during the early stages of the plant is rather slow. As the plants grow, shade should be made lighter, but the plants should not be exposed to the full sun all at once. In about six months' time the plants should have grown sufficiently for transplanting but where plants are easy to remove from the nursery to the field they can be allowed to grow even up to three or four feet in the nursery. With little care even larger plants can be transplanted.

If only a few trees are to be planted as is done in village gardens, it would always be better to plant seeds straight away provided they can be protected from damage and watered and taken care of until about 3 or 4 feet high. When seeds are planted at stake it is advisable to plant two seeds in each hole and remove the weaker plant at a later stage.

Only the best nuts from well-known heavy-bearing trees should be selected for seed purposes. Seed nuts should be large and well-formed.

PLANTING.

Nutmegs should be planted at distances varying from 25 to 30 feet apart in large holes filled up with good surface soil mixed with well decomposed cattle manure. These holes may be as large as possible—the minimum size should be $2\frac{1}{2} \times 2\frac{1}{2}$ feet and about the same in depth. In planting care should be taken to see that the tap root is not bent or placed in a crooked position. Unless the tap root has been placed straight the growth will be retarded. This is a most important point to remember in transplanting nutmegs. After properly placing the plants in the centre of the hole, press the soil firmly around the plant. In lifting plants from the nursery care should be taken not to damage the tap-root in any way. When transplanting from bamboo pots or baskets, see that the tap-root is straight. Planting out should be carried on at the commencement of the rainy season. If dry weather intervenes it will be necessary to shade the young plants and give sufficient water daily until they have struck root and begun to grow. Different conclusions have been arrived at as to the amount of shade necessary for nutmeg. In some countries nutmegs are planted in the open. In Ceylon the nutmeg has always done better under shade.

CROPS.

Grown under favourable conditions nutmeg trees will commence to bear from about the 7th year, but generally from about the 9th or 10th year. The writer, however, can point to cases where the tree yielded a small crop of fruits in the fifth year from the planting of the seed. About the 25th year, a tree attains a good producing state and would produce well for 40 or 50 years, or even longer. The tree at Gohagoda to which reference has already been made has been yielding the same heavy crops, according to the owner, for at least the last 40 years. Quite recently the writer was shown a tree at Deegala, said to have been planted in the early sixties, which gave from May 1923 to June 1924, a crop of 3,600 fruits, the average weight of the nuts being 90 to the pound. Another well-known tree on the Kandy-Galagedera road side, said to have been planted before the Katugastota bridge was opened, that is, in the fifties of the last century, is still producing extraordinarily good crops. The old trees at Peradeniya are now about 80 years of age and invariably yield heavy crops annually.

Up to about the 20th year the crop would normally be from 400 to 600 nuts per tree. The yield increases until about 25 or 30 years old, when a crop of 3,000 to 4,000 nuts per tree per year is not extraordinary in the Kandy district. Of the 80 trees of which the writer has obtained facts and figures, only 12 trees above the age of 25 years have given less than 2,000 nuts per tree per year.

The nutmeg tree bears all the year round. In Kandy the main crops are gathered in June-July and December-January. The nuts take about 6 months from the flower to attain the ripe stage. When quite ripe the fruits open and show the nut with its network of brilliant red mace. In a day or two after opening the nuts fall to the ground. They are then picked up or the ripe fruits are gathered from the tree by means of a hook attached to a long stick. The mace is removed from the nuts, and both the mace and nutmegs are dried in the sun for a couple of weeks before they are ready for the market.

On an average, 500 good fruits will give a pound of mace. When fresh, the mace is of a scarlet colour. On drying it turns into a yellowish brown colour.

During 1923-1924 crop, the following were the rates paid by the local buyers, chiefly Moor traders :—

Nuts, including the mace, if paid for on the tree	-/15 to -/20 cents a hundred
Nuts brought to the boutique	-/20 to -/25 cents a hundred
Mace, gathered freshly	-/50 cents per pound
Mace, dried	Re. 1/25 per pound

One local trader, operating in a small area, made up a consignment of 14 cwt. of nutmegs (roughly 160,000 nuts) and 2½ cwt. of mace during the last crop.

THE SUN-DRIED POONA FIG.

G. S. CHEEMA, M. Sc.,

Horticulturist to the Government of Bombay;

and

S. R. GANDI B. Ag.,

Bombay Agricultural Department.

The growing of figs in Western India is almost a speciality of the Poona District. But, inasmuch as they will not carry far in good condition, the cultivation, for which the tract is very suitable, cannot expand beyond a very small area. At the same time, the Bombay Presidency alone imports nearly 5 lakhs of pounds of dried figs from abroad each year, chiefly from the Persian Gulf, Afghanistan and Greece. The best among these figs are sold at Re. 1·8 per lb. in the months of August and September in the Bombay market, but if the Poona figs can be dried satisfactorily and put on the market, they can be sold at ten annas a pound and still yield a handsome profit, and will be in great demand, especially from June to September, when there is a scarcity of foreign figs.

In any case dried figs have a world market. The principal exporting centres before the war were Turkey (by far the largest), Italy, Greece and Algeria, while the large consuming countries were the United Kingdom, the United States of America, Austria-Hungary, France and Russia. To capture the foreign market is perhaps a far distant goal, but it is certainly well worth while to see whether good dried figs can be economically produced suitable for the Indian market. If this were found possible, the present area of figs in the Poona District (1,054 acres) would soon rapidly increase.

The Poona fig is a medium-sized, bell-shaped, light purple-coloured fig and is, in good samples, nearly six inches in circumference at the broadest end. The stalk is long and the apex flat. The skin is thin ridged, slightly downy, and is easily removable. The pulp is rosy red. The seeds are soft and without a kernel. The average weight of the fresh fruit is one and a half ounces. On analysis, in the chemical laboratories of the Bombay Agricultural Department, the fresh fruit gave the following figures :—

	Per cent.
Moisture	75·0
Reducing sugars	15·2
Non-reducing sugars	2·1
Total sugar	17·3

The completely dried fig gave the following additional data on analysis:—

	Per cent.
Ash	3·2
Ether extract	0·7
Proteids	4·7
Digestible carbohydrates ...	89·3
Woody fibre	2·1

The dried figs which we have been able to prepare from these fruits are not so sweet and aromatic as the first grade Smyrna fig, but their size, colour and the softness of the meet are very attractive. Their market quality is at least as good as that of any dried figs available in the local market, and is probably superior to all. On analysis they gave the following figures, compared with those of foreign figs available :—

	Moisture	Reducing sugars
	Per cent.	Per cent.
Sun-dried Poona fig - -	19·25	45·95
Persian fig. Sample 1 - -	19·45	46·30
Persian fig. Sample 2 - -	19·90	45·70
Afghanistan fig - -	19·04	46·64
Grecian fig - -	19·14	46·50

The process of drying and curing figs differs somewhat in different countries, largely on account of the differences in the cultivated figs themselves. They are extensively dried in Turkey in Asia, Greece, Italy, France, Spain, Portugal and Egypt and more recently in California. In Asia Minor and Greece, figs are only sun-dried on drying floors. In Italy, figs are split lengthwise, dried in the sun, dipped for a moment in boiling water, which is then drained off. In France they are exposed to the sun as in Turkey,

and then after two or three days' exposure, they are sweated for forty-eight hours in boxes and again finally dried in the sun. In California fresh figs are treated with burning sulphur fumes. Salting of fresh or half dried figs is also regarded as an important operation in many centres, but its use with the Poona figs has not, in our experience, increased the market value.

A series of experiments with the drying of the Poona fig has led to the following process as suitable to them.

Well ripened figs are carefully picked. Careful picking is essential. The contents of figs subject to careless picking always ooze out while drying, and attract ants and flies during the drying process. Fresh fruits are then spread in single layers and exposed to moist sulphur fumes in a closed wooden box. The exposure to moist sulphur fumes bleaches the fruits and makes them semi-transparent. The fumigation, too, checks the growth of micro-organisms, which would otherwise spoil the fruits during the curing period. The simplest method of fumigating with sulphur fumes is to ignite flowers of sulphur below perforated trays, which are made to slide one above the other on cleats nailed to the sides of an ordinary closed wooden box. The lowest tray, which is at least eighteen inches above the bottom of the box, is moistened with water and does not contain any fig.

Numerous experiments with various modifications of the treatment lead to the conclusion that twenty to thirty minutes' exposure to sulphur fumes is essential to get tasteful produce. Longer exposure, however, encourages acidity which is undesirable. If the figs are not sulphured, the final colour is dark and unattractive, and a preliminary dipping in boiling water containing salt gave no advantage, for though the taste was good, yet the final colour was not very attractive and the figs took a little longer to dry.

Immediately after sulphuring in the manner described, the figs are exposed to the sun in open trays and turned over daily in order to get the fruit evenly dried and semi-transparent in appearance. If this operation is neglected, the bright appearance of the dried fruit is lost.

The months of April and May seem to be the best for drying figs in the sun, as there is then no fear of rain. Five days are needed for completing the drying properly, and the figs, if well dried, are pliable and semi-transparent, and are reduced to a little less than one-third the original weight. The moisture contents of the dried figs range between 17 and 22½ per cent.

Before drying is completed, figs are pulled flat as evenly and neatly as possible to economize packing space and to improve the market appearance. Neatly pulled figs take a circular shape with their eyes in the centre on one side and the stalk on the other. If these instructions are carefully observed, a product much superior to the commonly obtainable foreign figs can be put in the market. There is, in fact great scope for developing a fig drying industry in the Bombay Presidency.

As this industry does not require any capital outlay, at any rate when conducted by the small cultivators who now grow figs, it can be easily taken up by the villagers as a cottage industry, particularly when the price of fresh figs is very low, as is usually the case in the month of May and the first half of June each year.—Agricultural Journal of India, Vol. XIX., Pt. 3.

NUX VOMICA IN MADRAS.

Although *Strychnos nux vomica* L., the tree from which nux vomica in its commercial form is obtained, is widely distributed throughout the tropical regions, the world's supply of the drug is almost entirely derived from India; two-thirds being furnished by the Madras Presidency. The important districts in which the drug is gathered and prepared are the Travancore and Cochin hills, on the Malabar coast, and the Ganjam, Godavery, and Nellore districts on the Coromandel coast.

Considering the economic value of nux vomica as the source of the alkaloids strychnine and brucine, the exploitation of the resources of India, says the United States Vice-Consul at Madras, has been greatly neglected. The trees are not cultivated, but are found in a wild state, and in general are of medium size, though occasional specimens reach 100 feet in height. At the end of the cold season in March large tufts of dull-green and white flowers appear. The fruits mature during the rains as bright-looking, brownish-yellow berries as big as a small orange containing a gelatinous pulp in which are embedded from one to five button-shaped seeds.

The wood of the tree is hard, takes a good polish and is sometimes used for fine cabinet work. It is also reputed to have a certain value as a febrifuge. However, its economic value is not sufficient to have called forth any special protective measures, so that in places the tree has almost disappeared as the result of careless exploitation.

So far as possible the right to gather the fruits is sold by a system of licenses, put up to auction by the forest officers of the different districts. As a matter of fact, however, owing to the difficulty of adequately supervising the work of gathering, nearly half the commercial supply comes on the market through more or less illegal channels. On account of this and the fact of its wild growth no estimates of the amount of crop are available either before or after the season. Production is rendered still more subject to fluctuation by the price changes in foreign markets, as the domestic market is almost non-existent in an organised sense. Therefore in periods of low prices the people do not find the gathering of the crops worth while and let much of it rot in the forests.

The actual work of gathering the seeds is done by forest tribes—Gonds, Santals, Mahars—to whom this work is a secondary occupation. The pulp is washed or rotted off and the seeds are spread on mats in the sun to dry. They are then sold to small middlemen or licensees, who dispose of them to larger middlemen, and eventually the crops are consolidated in the hands of the large exporters at Madras, Cocanada, or Cochin. This method of collection is obviously more or less unsatisfactory.

The exporters wash and sort the seeds, picking out the floaters or underweight ones and broken pieces. They are then put up in bags of 164 or 182 pounds and sold as 'general average of the crop, Europe cleaning.' The culls and underweights bring, as a rule, less than half the prices of the cleaned seeds, and in years of low demands may remain unsold.

The crop usually begins to arrive on the market in good quantities in December, and the gathering season extends through the cold weather up to March or April. Although the seed can be kept for long periods, storing does not appear to be a common practice.

The most important countries of consignment are the United Kingdom and the United States. A considerable amount of the exports to Great Britain is said eventually to find its way to America.—Indian Scientific Agriculturist, Vol. V., No. 5.

MARKET RATES.

MARKET RATES FOR SOME CEYLON PRODUCTS.

(FROM THE CEYLON CHAMBER OF COMMERCE WEEKLY PRICE CURRENT, DATED 11th AUGUST, 1924.)

NAME OF PRODUCE		CURRENT PRICE Rs. cts.	at	Rs. cts.	REMARKS
CACAO—(At Buyer's Stores)					
Estate—Finest	per cwt.	58 00	,,	66 00	
Do Medium	do	40 00	,,	53 00	
Do Common (Black)	do	10 00	,,	20 00	
CARDAMOMS					
All round parcel well bleached	per lb.	... ...	,,	... ...	
Do do medium	do	... ...	,,	... ...	
Special assortment 0 & I only	do	... ...	,,	... ...	
Seeds	do	... ...	,,	... ...	
Green	do	2 25	,,	2 40	
CINNAMON QUILLS—(At Buyer's Stores)					
Ordinary assortment (in bales of 100 lb. nett)	per lb.	0 65	,,	0 70	
No. 1	do	0 69	,,	0 73	
No. 2	do	0 67	,,	0 71	
No. 3	do	0 62	,,	0 67	
No. 4	do	0 57	,,	0 65	
CINNAMON CHIPS—Maradana, (At Buyer's Stores) (in bags of 56 lb. nett) per candy of 560 lb.		60 00	,,	65 00	
CITRONELLA OIL—(ex-Seller's Stores without packages) ...	per lb.	1 90		2 00	
COCONUT—(Desiccated) Granulated goods (Delivered at Wharf or Buyer's Stores) ... ... Assortment: Medium 50 per cent. Fine 50 per cent. ...	per lb.	0 21¾	,,	0 22¼	
COCONUT OIL—					
White Oil f.o.b	per ton	... ...		625 00	
Ordinary Oil do	do	585 00	,,	595 00	
COPRA— No. 1 quality per candy of 560 lb. Calpentyn, Estate, Ordinary quality (Maravila), Cart Do do		82 00	,,	87 00	
FIBRES—(At Buyer's Stores)					
Coconut Bristle No. 1	per cwt.	11 00	,,	12 50	
Do No. 2	do				
Coconut Mattress No. 1	do	2 80	,,	3 10	
Do No. 2	do				
Coir yarn, Koggala Nos. 4 to 9	do	12 00	,,	25 00	
Do Colombo Nos. 3 to 7	do	12 00	,,	25 00	

PLUMBAGO		X. B. Rs. cts.	at	Rs. cts.	B Rs. cts.	at	Rs. cts.	B. E. Rs. cts.	at	Rs. cts
Ordinary Lumps	per ton	250 00	at	350 00	215 00	at	250 00	150 00	at	180 00
Chips	do	160 00	,,	250 00	150 00	,,	200 00	100 00	,,	140 00
Dust	do	100 00	,,	175 00	70 00	,,	125 00	40 00	,,	75 00
Do Flying	do	60 00	,,	145 00	40 00	,,	95 00	25 00	,,	60 00

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st AUGUST, 1924.

Province, &c.	Disease	No. of Cases up to date since Jan 1st, 1924	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	935	306	345	519	57	14
	Foot-and-mouth disease	1570	457	1330	13	227	—
	Anthrax	7	—	—	7	—	—
	Hæmorrhagic Septicæmia	6	—	2	4	—	—
Colombo Municipality	Rinderpest	714	316	*			
	Foot-and mouth disease	120	75				
	Anthrax	—	—				
	Rabies	2	2	—	2	—	—
Cattle Quarantine Station	Rinderpest	10	—	*			
	Foot-and-mouth disease	27	—				
	Anthrax	141†	23				
	Pleuro-Pneumonia (in goats)	93	8	—	‡		
Central	Rabies (Dogs)	12	—	—	12	—	—
	Foot-and-mouth disease	716*	261	490	10	216	—
	Anthrax	8	—	—	8	—	—
	Hæmorrhagic Septicæmia	1	—	—	1	—	—
	Piroplasmosis	4	—	4	—	—	—
	Mange (in Buffaloes)	6	2	4	—	2	—
Southern	Rinderpest	84	68	27	49	8	—
	Foot-and-mouth disease	2	—	2	—	—	—
	Anthrax	—	—	—	—	—	—
Northern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	—	—	—	—	—	—
	Anthrax	—	—	—	—	—	—
	Hæmorrhagic Septicæmia	98§	—	3	95	—	—
Eastern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	9	8	9	—	—	—
	Anthrax	—	—	—	—	—	—
North-Western	Rinderpest	279	36	95	165	8	11
	Foot-and-mouth disease	1178	637	915	5	256	2
	Anthrax	12*	—	—	12	—	—
	Rabies (Dogs)	1	—	—	—	—	1
	* 1 dog						
North-Central	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	109	1	109	—	—	—
	Anthrax	—	—	—	—	—	—
Uva	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	—	—	—	—	—	—
	Anthrax	3	—	—	3	—	—
	Black Quarter	26	—	—	26	—	—
Sabaragamuwa	Rinderpest	7	7	1	6	—	—
	Foot-and-mouth disease	1514	566	1406	5	103	—
	Anthrax	12	—	—	12	—	—
	Hæmorrhagic Septicæmia	3	—	—	3	—	—
	Rabies (Dogs)	2	—	—	1	—	1

* Up to end of July. Figures for August not yet to hand.
† 2 cases amongst cattle, the rest amongst goats. 93 amongst 97 goats imported by Mr. C. E. A. Dias on 5th March, the balance 4 animals were destroyed on 18th August.
‡ 37 cases mouth disease in goats. § 23 cases amongst goats.

M. CRAWFORD,
Acting Government Veterinary Surgeon.

Colombo, 6th September, 1924.

METEOROLOGICAL
AUGUST, 1924.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of Cloud 0=clear 10=overcast	Mean Wind Direction during Month	Daily Mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy Days	Rainfall: Difference from Average
	°	°	%			Miles.	Inches		Inches
Colombo Observatory	81·4	+0·4	80	8·2	SW	165	4·53	13	+1·59
Puttalam	82·5	+0·9	75	4·2	SW	291	0·15	2	- 0·58
Mannar	84·8	+1·6	74	7·5	SW	241	1·90	2	+1·32
Jaffna	83·3	+0·5	77	7·6	SW	369	3·28	5	+1·78
Trincomalee	85·6	+0·8	66	6·9	WSW	258	3·39	5	- 0·73
Batticaloa	84·6	+0·6	67	5·7	Var	124	3.79	8	+1·60
Hambantota	81·8	+0·4	78	4·7	WSW	384	0·51	8	- 0·72
Galle	80·2	+0·2	82	6·3	W	329	4·09	19	- 1·33
Ratnapura	80·4	+0·2	81	7·5	—	—	23·98	22	+12·05
Anu'pura	83·7	+0·1	70	6·5	—	—	1·26	2	- 0·53
Kurunegala	80·4	—0·5	79	7·4	—	—	5·57	14	+2·09
Kandy	76·1	+0·3	80	8·0	—	—	9·68	20	+3·99
Badulla	75·3	—0.1	76	7·0	—	—	5·63	9	+2·41
Diyatalawa	71·2	+1.1	67	7·8	—	—	1·46	10	- 2·03
Hakgala	62·5	+0·8	84	8·1	—	—	5·07	20	+0·51
N.' Eliya	61·3	+1·9	86	8·6	—	—	11·57	22	+3·66

During the month the rainfall was, generally, in excess over the greater part of the hill-country, more particularly on the western slopes, and in the country lying between the hills and the southern half of the western coast. Around the coast there was on the whole, as much deficit as excess, and the remainder of the island, including the eastern fringe of the hill country was nearly everywhere in deficit.

Heavy rains starting about August 6th and continuing, with occasional breaks, almost till the end of the month, caused floods up-country and in the Kelani Valley, and washaways on the railway and roads.

There were 23 falls of over 5 inches in the 24 hours, reported during the month, from 18 raingauge stations. Of these, three falls were 10 inches or over, a fall of 11·75 inches at Kellie estate, on the 10th-11th; one of 10·20 at Ingoya estate, Kitulgala, on the 11th-12th; and one of 10·00 inches on the 11th-12th at Watawala.

The rains seem to have been most intense between the 7th and the 15th, and on the lower western slopes of the hills. One raingauge, at Watawala, registered over an inch a day for 11 days, the 7th to the 17th inclusive, the total amount of rain falling in that period being 36·43 inches. Seven other raingauges, Ingoya estate, Kenilworth estate, Maliboda estate, Blackwater estate, Carney estate, Watagoda and Padupola registered over an inch a day for 9 days, the total rainfall for the 9 days being, in most cases, well over 30 inches

As a contrast in a stretch of country to the east and north-east of Puttalam, there was no rain registered during the whole of August.

The barometer was slightly below the average during the month, the gradient, however, being practically normal. Wind was rather above the average strength, the mean direction varying from west to south-west in different parts of the coast.

Temperature was nearly everywhere slightly above normal. The cloudiness, also was in excess, except at Puttalam. The mean humidity varied from about 80 per cent. in the south-west of the island to between 65 per cent. and 70 per cent. in the lee of the hills.

H. JAMESON,
Acting Supdt., Observatory.